THE FOUNDRY

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The Great Gathering of Foundrymen at Chicago

Programs of the Conventions of the Allied Associations and Details of the Exhibition of Foundry Supplies and Equipment

AFTER a lapse of over a decade the foundrymen's conventions return to Chicago. The 12 years intervening have witnessed more growth, change and progress in the foundry industry than almost any preceding period that could be selected. During these years, the great movement toward replacing hand labor with mechanical appliances in every department of casting shops was brought to complete fruition; the old days of rule-of-thumb in foundry operation have passed forever and the era of scientific management—using the phrase in its practical sense—has arrived. The contrast between the Chicago convention of 1901 and the Chicago convention and exhibition of 1913 will form a striking commentary on the rapidity with which industries move forward in the United States. Twelve years ago the convention was held by a single organization; today three great allied foundry associations hold their meetings simultaneously during Founders' week. In 1901 the idea of having an exhibition of shop equipment in connection with the conventions had not been conceived. In fact, it was five years later, 1906, before the first exhibit under the auspices of the Foundry Supply Association was held in Cleveland. The 1913 show of the Foundry & Machine Exhibition Co. in Chicago will require one of the largest exposition buildings

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President, Foundry & Machine Exhibition Co.

H. D. MILES
President, American Foundrymen's Association

ROBERT H. WALKER
President, Associated Foundry Foremen

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President, American Institute of Metals

CHICAGO'S IMPOSING SKY LINE

in the United States and will not be surpassed by any of the industrial displays that have been held heretofore in this country.

The exposition will be housed in the International Amphitheatre, Forty-second and Halsted streets, Chicago. This structure is located within 20 minutes' ride from the loop district of Chicago and is reached by the South Side elevated railway and by six surface car lines. It also is readily accessible by automobile, via Forty-third street, which connects with all of the north and south boulevards.

The building consists of a central arena, 100 x 200 feet, surrounded by an amphitheatre, together with four wings or exhibition courts arranged in the form of a capital H. It has no basement and is, therefore, specially adapted for exhibiting heavy machinery. Immediately adjoining the exhibition building is the new Stock Yard Inn, a rambling structure of English architecture. It has 175 sleeping rooms and all the appointments of a modern hotel.

A combined floor area of over 100,000 square feet is available for the show and early in September over 60,000 square feet had been sold for exhibition purposes. There will be approximately 170 individual exhibits, embracing everything used in any department of the foundry. In brief, the Chicago show will be a living catalog of foundry and shop equipment.

The entire scope of the foundry industry will be reflected on the floor of the International Amphitheatre, for the display will not only cover mechanical appliances and supplies designed primarily for foundry use, but practically everything which may be found in a modern metal working plant. For instance, there will be over 40 working exhibits of machine tool companies, this being one of the largest machine tool displays of the year. The signal advances in molding machine practice which have taken place during the past 12 months will be exemplified by working displays at the Chicago show. Practically every size and type of molding machine manufactured in the United States will be available for the inspection of the visiting foundrymen. The exhibits also will illustrate the extensive use of electric and compressed air appliances in modern shops and foundries. In addition, the visitor will learn of many novel methods of handling materials, including the application of magnets, unique types of conveyors, elevators, etc. The problem of sand-handling, which is a serious one in a large shop, will be fully covered. The show also will include many examples of modern pattern shop machinery operating under working conditions.

LARGE MOWER WHEEL FLOOR OF THE McCORMICK WORKS OF THE INTERNATIONAL HARVESTER CO.

Conventions of Allied Associations

The exhibition opens on Friday, Oct. 10, and remains open continuously during the day and evening until Saturday, Oct. 18, Sunday, Oct. 12, excepted. It has been suggested that companies which have a large number of men to send to the exposition will take advantage of the opportunity afforded them to have their men attend in relays, thereby obviating interference with shop operations.

The conventions of the allied organizations, including the American Foundrymen's Association, the American Institute of Metals and the Associated Foundry Foremen, will be held simultaneously from Tuesday until Thursday,

AS SEEN FROM THE WATER FRONT

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inclusive, Oct. 14 to 16. The registration booths, however, will be open Monday, Oct. 13. Headquarters for the three associations have been established at the LaSalle hotel. The professional sessions of the American Foundrymen's Association and the American Institute of Metals will be held simultaneously in the two large banquet rooms on the top floor of the building. The convention will be opened by a joint meeting Tuesday morning, Oct. 14.

The Chicago foundrymen have prepared a simple, dignified and comprehensive program of entertainment. In addition to the recreation features in which everyone who registers at the convention will participate, special arrangements have been made so that the leading foundries, steel plants and other industrial establishments in Chicago and vicinity may be inspected at the convenience of the visitors. A special entertainment program also has been outlined for the many ladies who are expected.

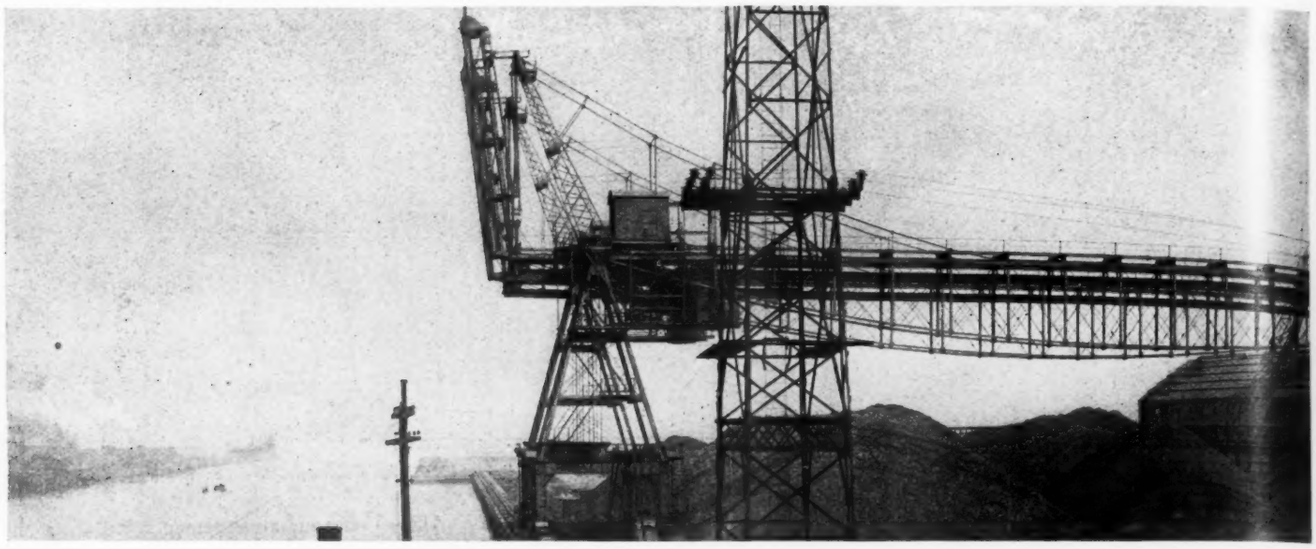
Local Committee

The work of preparing for the convention has been in the hands of an able local committee, headed by Charles A. Plamondon, of the A. Plamondon Mfg. Co. Mr. Plamondon has been connected with the foundry business for many years, and 20 years ago, in 1893, he was the first president of the Western Foundrymen's Association, which was the pioneer foundry organization in the Chicago district. David R. Forgan, treasurer of the local committee, is president of the National City Bank and is also one of the leading financiers of the country. The secretary, H. Cole Estep, is the associate editor of THE FOUNDRY. The chairman of the finance committee, J. A. Galligan, is head of the coke sales department of Pickands, Brown & Co. Previous to his connection with this concern he was assistant general purchasing agent of the Allis-Chalmers Co. William Francis, head of the reception committee, has also been prominently identified with the foundry business in Chicago for many years. He is now president of the Francis & Nygren Foundry Co. Charles B. Carter, chairman of the entertainment committee, is a special sales representative of the American Brake Shoe & Foundry Co. Mr. Carter began his foundry training on the floor and has worked up through the various departments of the business. O. J. Abell, chairman of the publicity committee, is western editor of the *Iron Age* and previous to his present connection was mining editor of THE IRON TRADE REVIEW. These men constitute the general committee, which has supervisory charge of all the convention arrangements. But a large measure of the credit for the great volume of work handled by the Chicago committee should be given to the many able members of the several sub-committees. The full personnel of the various committees is as follows:

Finance Committee.—J. A. Galligan, Pickands, Brown & Co., chairman; A. N. Hayes, Johnston & Jennings Co.; Geo. W. Pyott, Pyott Foundry Co.; H. N. Wade, U. S. Wind Engine & Pump Co.; David Evans, Chicago Steel Foundry Co., and E. J. Welch, of the E. J. Welch Foundry Co.

Reception Committee.—Wm. Francis, Francis & Nygren Foundry Co., chairman; E. L. Cleveland, Garden City Foundry Co.; H. O. Lange, Ferguson & Lange; G. S. Burtis, Brady Foundry Co.; J. P. O'Neil, Western Foundry Co.; W. B. Greenlee, Greenlee Foundry Co.; L. S. Rice, Allis-Chalmers Mfg.

MOLDING MOWER WHEELS AND FRAMES IN THE GRAY IRON FOUNDRY OF THE DEERING WORKS



NEW BLAST FURNACE PLANT OF THE IROQUOIS IRON CO., SOUTH CHICAGO. EACH

Co.; Thomas Jones, W. A. Jones Foundry Co., and Irvin McDowell, McDowell Foundry Co.

Entertainment Committee.—Charles B. Carter, American Brake Shoe & Foundry Co., chairman; E. F. Axner, Illinois Steel Co.; Thomas Cummings, T. A. Cummings Foundry Co.; James Wood, Sheffield Foundry Co.; C. M. Eddy, R. M. Eddy Foundry Co.; Frank Smith, Hewitt Mfg. Co.; I. E. Burtis, J. A. Brady Foundry Co.; J. G. Garrard, Northwestern Malleable Iron Co., and James E. Evans, of the S. Obermayer Co.

Publicity Committee.—O. J. Abell, *Iron Age,* chairman; H. L. Hanson, David Evans & Co.; A. O. Sonne, Rogers, Brown & Co.; Richmond Nicholas, Hickman, Williams & Co., and Alex. B. Hawes, of Matthew Addy & Co.

When the first handful of settlers built their rude cabins about the blockhouse which had been reared at the junction of the Chicago river and Lake Michigan, they little thought that their swampy homesteads, in two generations, would be transformed into one of the world's greatest industrial centers. And if there was anyone among them who was familiar with the young American iron industry which was then struggling for existence in Pennsylvania and along the Atlantic seaboard, he certainly never dreamed that the new, raw Chicago to which he had emigrated would become the country's greatest foundry center while his sons yet lived.

At the time Chicago was settled, all manufacturing was confined to the east where ore and fuel were available. The iron and copper ores of Lake Superior slept undisturbed under the pine forests of Michigan and Minnesota; the prairie sod of Illinois gave no hint of the coal beds that lay beneath; the zinc and lead in southern Wisconsin hid itself beneath the roots of ash and oak trees. Even if these mineral treasures had been fully developed they would have been of practically no value, for man had no means of transferring his goods except by ox cart, schooner or canal boat.

THE LINK BELT CO.'S STEEL AND GRAY IRON FOUNDRY

Then just before the Civil War came the railroads and the industrial face of the country was changed almost overnight. Hitherto inaccessible resources were made available; transportation was cheap and easy. Population poured into the middle west. Chicago, located at the strategic point, became a great railroad center, and being such grew to be a most favorable point for manufacturing. Iron is the basis of all manufacturing, so today Chicago has more foundries than any other city in the United States, leading New York by 25 per cent. Also, as a steel center, Chicago is second only to Pittsburgh.

Chicago Leads

With a population of 2,185,283, there are 169 foundries of all kinds within the city limits of Chicago. Of this total, 101 melt gray iron, 14 make steel, nine produce malleable iron and 60 are devoted exclusively to the casting of brass, aluminum and other non-ferrous metals. In addition, there are 32 brass melting departments operated in connection with iron foundries in the city. Fifty-four

STACK HAS A CAPACITY OF 300 TONS DAILY; ROGERS, BROWN & CO., SALES AGENTS

of the non-ferrous metal foundries are equipped to make aluminum castings. There are seven foundries in Chicago devoted exclusively to the manufacture of steel castings and one very large shop operates exclusively on malleable castings. A number of the Chicago concerns control more than one shop; among these are the Crane Co., with four foundries, the Griffen Wheel Co. with three, the International Harvester Co. with two, the American Brake Shoe & Foundry Co. with three, and the National Malleable Castings Co. with two foundries, all within the city.

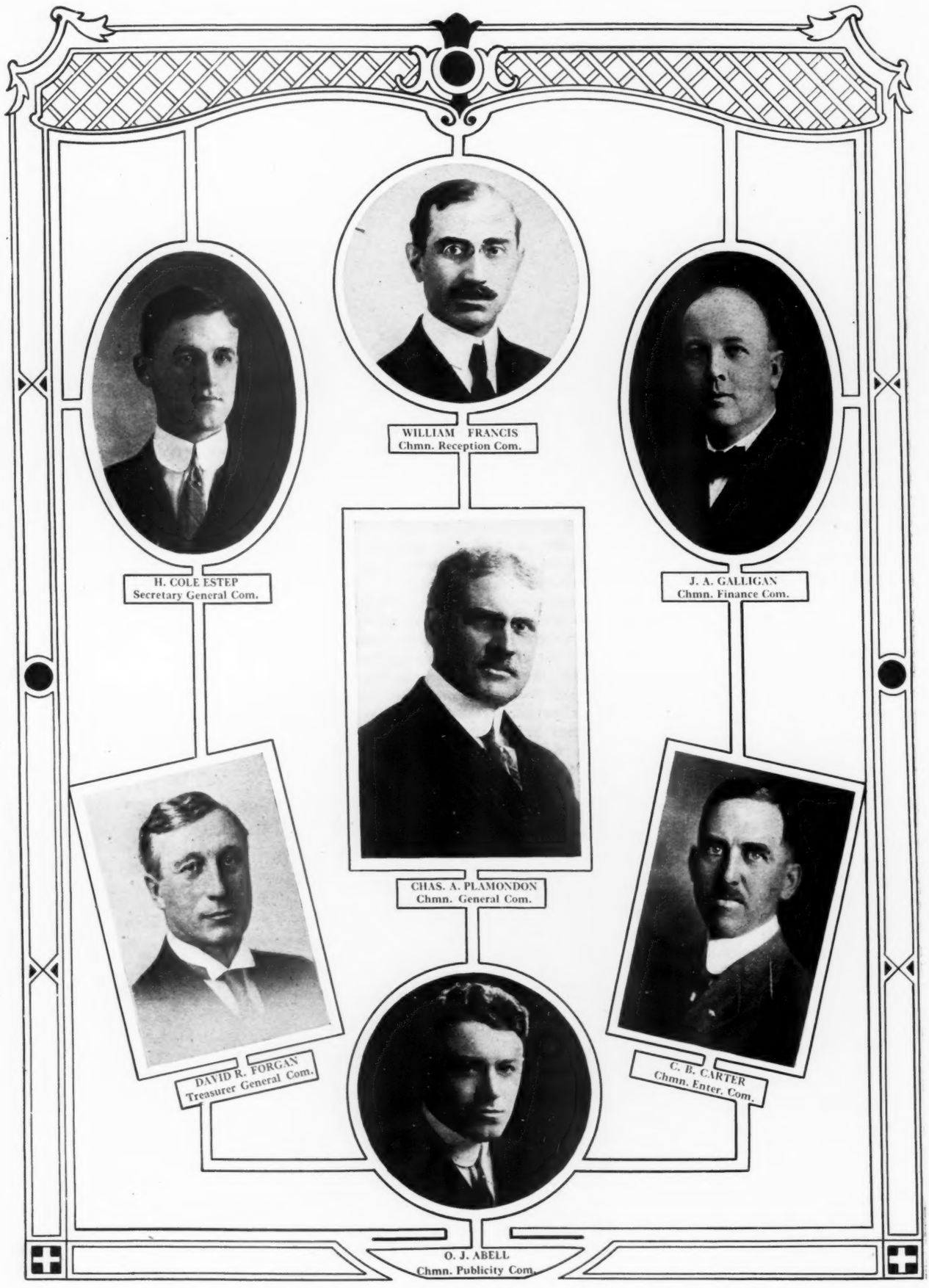
Many Suburbs

A better idea of the extent of the foundry business in Chicago may be gained by considering not only those shops located in the city itself, but also the numerous industrial suburbs which surround the city. In the Chicago district, which will be defined as that territory embraced within the Chicago Outer Belt Line, including Waukegan on the north, the Fox river on the west and Gary on the south, there are 235 foundries of all kinds. They are distributed among various suburban towns as shown in the following table:

Chicago	169
Evanston	1
North Chicago	1
Waukegan	2
Melrose Park	2
Elgin	3
St. Charles	3
Geneva	2
Batavia	6
Aurora	13
Joliet	11
Harvey	4
Chicago Heights	8
Indiana Harbor, Ind.	1
Hammond, Ind.	4
East Chicago, Ind.	4
Gary, Ind.	1
	235

Although best known for its manufacturing foundries, the jobbing foundry business in Chicago is by no means to be dismissed lightly. There are about 40 shops in the city specializing on jobbing work with an annual capacity of approximately 300,000 tons of castings. Many of these plants are equipped with the latest mechanical appliances and the cost of making miscellaneous castings in the Chicago district is said to be as low as anywhere else in the country. The jobbing foundries of Chicago are not limited by the city boundary lines in their sales territory, but distribute their product throughout the entire western half of the United States. It is a well-known fact on the Pacific coast that the foundries of Seattle, Tacoma, Portland, San Francisco, etc., frequently have to cope with competition from Chicago shops when bidding on work in their own localities. The volume of work is so large that in many cases the Chicago jobbing foundries have been able to specialize along certain lines, thus reducing their costs. The Francis & Nygren Foundry Co., for instance, devotes practically its entire effort to the manufacture of refrigeration machinery castings. The Tarrant Foundry Co. makes a large number of printing press castings and the Western Foundry Co. operates a very large plant exclusively for the manufacture of light castings in large quantities. Pro-

A CORNER IN A LARGE CHICAGO STOVE FOUNDRY



MEMBERS OF THE GENERAL COMMITTEE IN CHARGE OF THE CHICAGO MEETING

minent among the manufacturing foundries in the Chicago territory are those operated by the agricultural implement makers, the sanitary ware and plumbing supply manufacturers and the railway supply concerns. The International Harvester Co. operates large foundries both at the Deering Works, 1748 Fullerton avenue, and the McCormick Works, at Blue Island and Western avenues. A new tractor foundry has also been built on Marshall boulevard. These shops are among the largest gray iron foundries in the world. The L. Wolff Mfg. Co. operates large gray iron, brass and aluminum foundries in connection with its business of producing sanitary ware, bath room fittings, etc. The practice in these shops is especially interesting on account of the intricate nature of the castings. Sanitary castings have very thin sections, large surfaces and complicated cores. In the production of pipe fittings, valves, etc., Chicago is pre-eminent due to the large plants of the Crane Co., located within the city limits. This corporation controls four foundries, three of which are operated on the continuous system. The newest of the four is the malleable foundry at Canal and Sixteenth streets. It is operated on the continuous principle with the molding room on the fifth floor and was described in detail in THE FOUNDRY, March, 1911.

Convention and Exhibition Program

Friday, Oct. 10.

9:30 a. m.—Opening of the eighth annual foundry and machine exhibition to be held in the International Amphitheater.

Saturday, Oct. 11.

11:00 a. m.—Chicago Foundrymen's Day at the exposition.

Monday, Oct. 13.

Registration and informal reception of visiting foundrymen at the La Salle hotel.

Tuesday, Oct. 14.

10:00 a. m.—Joint meeting of the American Foundrymen's Association, American Institute of Metals and the Associated Foundry Foremen at La Salle hotel with address of welcome by Mayor Harrison.

2:00 p. m.—Separate professional sessions of the American Foundrymen's Association and American Institute of Metals at the La Salle hotel.

Wednesday, Oct. 15.

10:00 a. m.—Separate professional sessions of the American Foundrymen's Association and American Institute of Metals at the La Salle hotel.

10:00 a. m.—Annual meeting of the Associated Foundry Foremen, College room, La Salle hotel.

12:00 noon. — Luncheon at Marshall Field & Co. for the ladies.

2:00 p. m.—Complimentary performance to foundrymen at Bismarck garden.

2:00 p. m.—Theater party for the ladies.

Thursday, Oct. 16.

10:00 a. m.—Separate professional sessions of the allied associations.

2:00 p. m.—Separate professional sessions of the allied associations.

7:00 p. m.—Annual subscription banquet.

8:15 p. m.—Theater party for the ladies.

Program American Foundrymen's Association

At the various meetings of the American Foundrymen's Association, which will be held at the La Salle Hotel, the following papers will be presented:

"How to Make a Time Study," by C. E. Knoeppel. This paper also will be presented before the American Institute of Metals.

"The Induction Furnace for Making Steel Castings," by Albert Hiorth.

"Core Tests and Specifications," by H. M. Lane.

"Use of Small Open-hearth Furnace for Steel Castings," by William Carr.

"The Need of Standard Specifications for Iron Castings," by R. S. MacPherran.

"Report of Committee on Industrial Education," by Carl Kreutzpointner.

"The Need of a Common-Sense Cost System in the Foundry," by E. W. Riker.

"Memoranda on Accident Prevention," by Thomas D. West.

"Some Difficulties in Pouring Steel Castings," by R. A. Bull.

"Gray Iron for Motor Car Castings," by H. B. Swan.

"Electric Steel Castings," by F. T. Snyder.

"A Study of the Annealing Process for Malleable Castings," by E. L. Leasman.

Address entitled "Educational Work of the General Electric Co.," by M. W. Alexander. This address will be delivered jointly before the American Foundrymen's Association and the American Institute of Metals.

"The Pattern Shop as Related to the Steel Foundry," by E. R. Swanson.

"Oxy-acetylene Welding and Cutting," by W. S. Hoyt.

"American Foundrymen's Association Standard Cost System," by Ellsworth M. Taylor.

"Specifications for Foundry Flour," by G. S. Evans.

"Foundry Education at the Carnegie Institute of Technology," by Prof. C. B. Connelly.

"The Determination of Bond in Molding Sand," by W. B. Saunders.

"Powdered Coal as a Fuel for the Foundry," by W. S. Quigley.

"Testing Molding Sands Under Commercial Conditions," by Prof. E. A. Johnson.

"Malleable Troubles," by Dr. Richard Moldenke.

"Patternmaking," by James Glass.

In addition, steel, malleable and gray iron topics will be discussed, particularly relating to the difficulties encountered in manufacture.

Railroad Shops

With 26 trunk line railroads centering in Chicago, it is only natural that the city should be the seat of a large number of railway supply concerns. Many of these operate large steel or gray iron foundries. The Griffin Wheel Co., which is said to make more car wheels than any other concern in the country, has three plants in the Chicago district. The Pullman Co. has a large shop in connection with its car works and the American Brake Shoe & Foundry Co. operates four shops including the new continuous foundry described in THE FOUNDRY, February, 1913.

Of the 14 steel foundries in the city of Chicago proper, three are operated on the open-hearth process, nine are equipped with converters and one makes electric steel castings exclusively. The crucible process is represented by the plant of the Chicago Steel Foundry Co. and the manganese steel process by the works of the Edgar Allen American Manganese Steel Co., at Chicago Heights.

The fact that there are 60 plants devoted exclusively to the production of non-ferrous castings, gives some conception of the development of the brass foundry industry in Chicago. A number of the brass and aluminum foundries do jobbing work, although most of the plants specialize along lines which have been found profitable. These include the manufacture of automobile castings, plumbing supplies, art bronze, bearing metals, hardware and brass or aluminum novelties.

It is only natural that a district containing 235 foundries should be well supplied with facilities for making pig iron and as a matter of fact there are six merchant blast furnaces in the Chicago district with five others in nearby tributary territory. The former include the two stacks operated by the Federal Furnace Co. and four by the Iroquois Iron Co., in South Chicago. Federal iron is sold by Pickands, Brown & Co., and the product of the Iroquois stacks by Rogers, Brown & Co. The output of these six stacks is approximately 600,000 tons per year. Two of the four Iroquois furnaces are new, having been completed early in 1912. They are among the most modern in the west and are each 80 feet high and 17½ feet in diameter, with a daily capaci-

Program American Institute of Metals

At the annual meeting of the American Institute of Metals the following reports and papers will be presented:

"Report of the Official Chemist," by Arthur D. Little, Inc.

"Report of the Bureau of Mines," by Dr. Charles L. Parsons.

"Report of the Bureau of Standards," by G. A. Clamer.

"Work in Metals of the Bureau of Standards," by G. K. Burgess.

"Nomenclature of Non-ferrous Alloys," informal discussion, by G. K. Burgess.

"The Brass Foundry of the Future," by C. P. Karr.

"How to Make a Time Study," by C. E. Knoeppel.

"The Efficiency Engineer in the Foundry," by E. A. Barnes.

"How Scientific Management Works in Our Plant," by C. B. Bohn.

"Core Room Economics," by O. F. Flumerfelt.

"Producer Gas," by E. F. Bulmahn.

"The Hering Electric Furnace for Melting Brass," by G. H. Clamer and Carl Hering.

"The Stassano Electric Furnace for Brass," by M. Petinot.

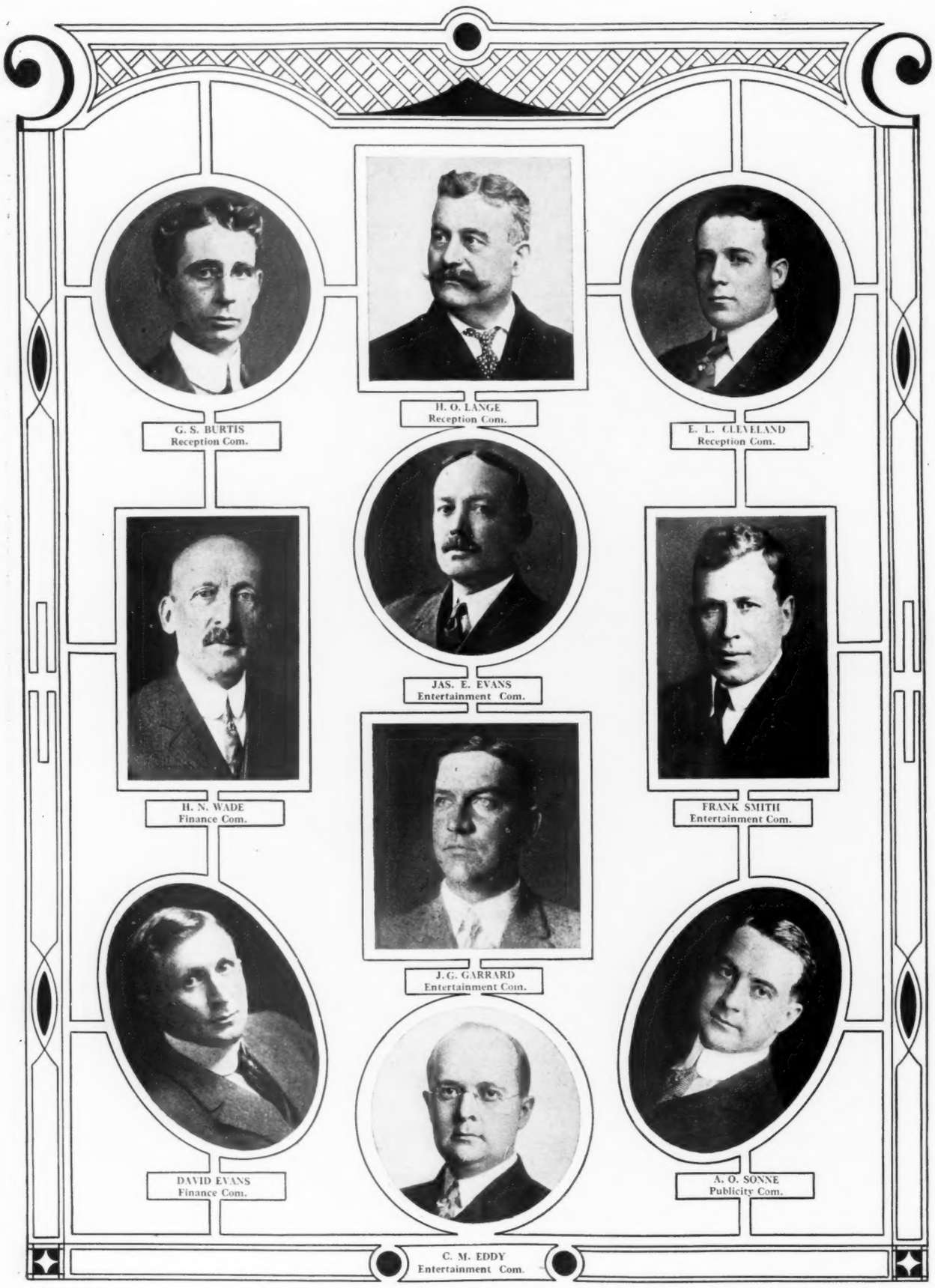
"Vaporization of Metals," by Dr. J. W. Richards.

"Electroplating," by C. F. Burgess.

"Fluxes for Soft Solders," by Walter Arthur.

"Aluminum Solders," by Walter Arthur.

"Melting Points," by H. W. Gillett.



SOME OF THE MEMBERS OF THE VARIOUS COMMITTEES IN CHARGE OF THE CHICAGO MEETING

ty of 300 tons. Competent authorities have estimated the consumption of merchant pig iron in the states of Illinois, Wisconsin, Minnesota, Iowa, western Indiana and western Michigan to be approximately 1,700,000 tons per annum.

The manufacture of coke naturally accompanies any considerable blast furnace development, but on account of the distance from the coking coal fields, the production of beehive coke would be unprofitable in the Chicago district. On the other hand, the immense population creates an enormous demand for gas, tar, etc., so that the by-product coke industry has been very thoroughly developed. The Semet-Solvay Co. has a plant of 300 ovens at South Chicago producing foundry and blast furnace coke exclusively. Forty of these ovens are new, having been finished Oct. 1. The same company owns 180 ovens at Milwaukee. Pickands, Brown & Co. are the sales agent for Semet-Solvay coke. A new plant embracing 36 Koppers ovens was completed early this year at Joliet, Ill., by the Coal Products Mfg. Co. This plant produces foundry coke exclusively. In addition to the ovens selling coke to the trade, the United States Steel Corporation has a battery of 260 ovens at Joliet and a plant containing 580 Koppers ovens at Gary. The latter is the largest by-product coke oven plant in the world. Its annual capacity is over 3,100,000 tons.

The Chicago district also is a steel-making center of primary importance. It includes the plants of the Illinois Steel Co., at South Chicago and Joliet, together with the new plant of the Indiana Steel Co., at Gary, and the works of the Inland Steel Co., at Indiana Harbor. These plants include mills for rolling all kinds of steel products such as billets, plates, shapes, sheets, bars and rails. The Joliet works of the Illinois Steel has an annual capacity of 660,000 tons of Bessemer steel, while the South works has a yearly capacity of 1,020,000 tons of Bessemer ingots and 790,000 tons of open-hearth ingots. The Gary plant has an annual capacity of approximately 2,500,000 tons of open-hearth steel. The Inland Steel Co. has recently added a second blast furnace and additional open-hearth equipment, giving it a total capacity of 500,000 tons of steel per year. Chicago is the home of the molding machine industry and in other ways is important as a foundry supply center. It includes one of the plants of the S. Obermayer Co. and the shops of the Whiting Foundry Equipment Co., together with the works of the Peterson-National Co., Brown Specialty Machinery Co., International Molding Machine Co., Henry E. Pridmore, Vulcan Engineering Sales Co., Bayley Mfg. Co., Chicago Pneumatic Tool Co., Mott Sand Blast Mfg. Co., Scully-Jones & Co., Kroeschell Bros. Co., Alfred Fisher, Calumet Foundry Equipment Co., and numerous others.

This article would not be complete without some mention of the foundrymen's organizations in Chicago. Among the local societies are the Chicago Foundrymen's Club and the Chicago Foundrymen's Association. The former, which has approximately 100 members, is a technical society devoted to the discussion of improvements in foundry practice. James Wood, of the Sheffield Foundry Co., is president and C. E. Hoyt, of the Foundry & Machine Exhibition Co., is secretary. The club holds several dinners and social meetings every winter, together with regular monthly meetings for the discussion of practical foundry topics. The membership is growing rapidly and it is expected that it will double within a year. The Chicago Foundrymen's Association, an employers' organization, with 36 members, confines itself to the jobbing foundries of the city. It has been effective in insuring stable labor conditions in the Chicago district. E. L. Cleveland, of the Garden City Foundry Co., is president, and W. M. Webster is commissioner. The offices of the association are in the City Hall Square building. In addition to the two local associations, the general offices of the National Founders' Association and the National Metal Trades Association are located in Chicago.

The Exhibitors and What They'll Exhibit

AJAX METAL CO., Philadelphia.—The various ingot metals manufactured by this company will be displayed, including Ajax plastic bronze, manganese bronze, phosphor bronze, acid bronze, hydraulic bronze, steam metal, red brass Nos. 1 and 2 and yellow brass Nos. 1 and 2, in addition to phosphor copper, manganese copper, silicon copper, Ajax bull babbitt metal and Ajax genuine babbitt metal; represented by H. L. Carpenter, G. H. Clamer, W. J. Coane and C. F. Hopkins.

ALBANY SAND & SUPPLY CO., Albany, N. Y.—A range manufactured by the Walker & Pratt Mfg. Co., Boston, Mass., all of the castings of which were molded in Albany sand, mined and shipped by the Albany Sand & Supply Co., will be exhibited. In addition, a display will be made of belt dressing; represented by Arthur T. Palmer and S. Marshall.

ARCADE MFG. CO., Freeport, Ill.—This company's exhibit will include 36 molding machines, comprising various sizes of Norcross jolt rammers, adapted to making molds and cores, Modern molding machines, squeezers, sand sifters, etc. A large number of these machines will be operated; represented by E. H. Morgan, Charles Morgan, L. L. Munn Jr., F. N. Perkins, August Christen, G. D. Wolfley, Henry Tscherning, B. C. Trueblood, Reeve Burton, G. W. Skinner, R. E. Turnbull and F. E. Boedeker.

ATKINS, E. C., & CO., Indianapolis.—A complete line of saws will be displayed, including sizes ranging from the smallest circular slitting saw to the largest metal saws used, as well as hack saw blades and hack saw frames in a complete variety of patterns, styles and shapes. A high speed power hack saw machine also will be shown in operation; represented by S. M. Perrigo, C. R. Hewitt, William de R. Knight, Lewis Oakey and C. H. Rowlson.

AUTOMATIC TRANSPORTATION CO., Buffalo.—Storage battery trucks for handling material in industrial plants will be shown in operation; represented by L. J. Goodsell.

BAIRD & WEST, Detroit.—This exhibit of by-product foundry coke will be made in conjunction with that of Pickands, Brown & Co., Chicago, and will consist of a replica of the rock of Gibraltar built entirely from foundry coke.

BARTLEY, JONATHAN, CRUCIBLE CO., Trenton, N. J.—A complete line of graphite products, including crucibles, retorts, stoppers, nozzles, stirrers, etc., for brass, bronze and aluminum foundry use will be shown; represented by S. H. Dougherty, H. D. Cole, L. T. Ward and Lewis H. Lawton.

BARTON, H. E., TOOL & SUPPLY CO., Chicago.—The products of the Stow Mfg. Co., Binghamton, N. Y., and the Pittsburgh Pneumatic Co., Canton, O., will be exhibited. The former display will consist of electric drills, portable flexible shaft, grinders and small motors, and the Pittsburgh Pneumatic Co.'s exhibit will consist of air tools, such as valveless chipping hammers, heavy duty valve hammers and riveters; represented by W. B. Smith and H. E. Barton.

BENJAMIN ELECTRIC & MFG. CO., Chicago.—Reflectors for electric lamps for shop use will be exhibited.

BENNETT-O'CONNELL CO., Chicago.—Plating equipment will be shown, including a dynamo direct-connected to an alternating current motor, a mechanical plating barrel and an electric cleaning and rinsing tank, which will be operated, an alternating current motor-driven polishing lathe also will be shown, as well as supplies used in connection with the electro-plating and polishing of metals.

BERKSHIRE MFG. CO., Cleveland.—This company will exhibit hand and power squeezer molding machines, coremaking machines, air compressors, flasks, vibrators, etc.; represented by R. H. York, W. A. Price, W. D. Fraser, F. Hulec, E. W. Sample, F. G. Stewart and G. L. Cannon.

THESE CONVENTIONS AND EXHIBITIONS MAKE ME SICK. MY TIME IS TOO VALUABLE TO WASTE THUSLY. "DUTY BEFORE PLEASURE" IS MY MOTTO
I
THE LULL BEFORE THE STORM
ME FOR THE CONVENTION. IF I ONLY GET ONE GOOD IDEA I'LL FEEL WELL REPAID!
Oct 10
I
SEIZING AN OPPORTUNITY
NOW TO GET MY "THINKER" BUSY. MY BOOK-KEEPER TELLS ME I'M LOSING MONEY. IF I ONLY HAD SOME GOOD PRACTICAL IDEAS, I'D SHOW A FEW THINGS TO SOME OF THESE FELLOWS THAT THINK THEY'RE REAL FOUNDRYMEN
II
ONE MONTH LATER
WOW! WHAT A BUNCH OF GOOD IDEAS! IT'S SURE A SHAME TO GET ALL THIS FOR NOTHING! SOME OF THOSE "DEAD" ONES BACK IN OUR VICINITY WILL THINK I'M CRAZY WHEN THEY SEE ALL THE IMPROVEMENTS THAT I'M GOING TO MAKE IN MY FOUNDRY
SAVE TIME AND MONEY
ECONOMY
MONEY SAVER
TIME SAVER
SAVE $
II
THE NEXT DAY
WELL BOYS, "SO-LONG"! I'M ALL THROUGH— CAN'T STAND THE PACE ANY LONGER. IT COSTS ME TWICE AS MUCH, AND TAKES ME THREE TIMES AS LONG TO MAKE A CASTING AS IT DOES THOSE OTHER FELLOWS. I'M LOSING MONEY AND MY CUSTOMERS ARE DISSATISFIED— I WONDER WHY IT IS!
III
ANOTHER MONTH LATER
GEE! I CAN'T WAIT TO GET BACK! I'M LOSING MONEY EVERY MINUTE THAT I'M AWAY— AND JUST BECAUSE MY FOUNDRY ISN'T UP-TO-DATE!
III
A FEW DAYS LATER
GUESS I'VE LEARNED MY LESSON ALLRIGHT! IF I EVER GET TOGETHER ENOUGH MONEY TO START IN BUSINESS AGAIN, BELIEVE ME "STEVERINO", I'LL ATTEND ALL THE FOUNRY CONVENTIONS AND EXHIBITIONS
CLOSED
IV
ONE MORE MONTH LATER
SO THOSE NEW IDEAS ARE MAKING LOTS OF MONEY FOR US ARE THEY? WELL I KNEW THEY WOULD! HURRAH FOR CONVENTIONS AND EXHIBITIONS! EVERYTIME I GO TO ONE IT MEANS BIGGER OUTPUTS AND LARGER PROFITS!
PROFITS
-Collart-
IV
A FEW MONTHS LATER

WH... ...TENED TO THE FOUNDRY PROPRIETOR WHO COULD SEE NOTHING IN CONVENTIONS AND EXHIBITIONS OF FOUNDRY EQUIPMENT, CONTRASTED WITH THE PROSPERITY OF ONE WHO ATTENDED REGULARLY

BESLY, CHARLES H., & CO., Chicago.—Various types of disc grinders will be operated and samples of oil, pressed steel ring chucks, etc., will be exhibited; represented by Edward P. Welles, Charles A. Knill, William H. Allen, Charles Munson, John Miller Jr. and Murdoch Campbell.

BIRKENSTEIN, S., & SONS, Chicago.—Ingot metals for brass and aluminum foundry use will be exhibited; represented by H. Birkenstein, H. Brown and L. Kahn.

BLYSTONE MACHINERY CO., Cambridge Springs, Pa.—A core sand and facing mixer with screen attached will be shown in operation; represented by W. E. Wright, W. J. Pees and Luther G. Conroe.

BROWN SPECIALTY MACHINERY CO., Chicago.—Three different types of core machines with dies will be displayed, in addition to a tapering machine and a core cutting-off and tapering machine; represented by E. A. Rich Jr., John Laycock and Robert Laycock.

BUCH'S, A., SONS CO., Elizabethtown, Pa.—All of the molding machines built by this company, with the exception of the gravity type, will be shown in operation. These will include hand-operated jar and squeeze and electrically-operated jar and squeeze molding machines. In addition, this company will display sample castings made on gravity and on jar and squeeze machines, cast iron floor flasks, tapered aluminum snap flasks, cast iron pattern plates, treated wood pattern boards, cast iron bottom plates, cast iron casings, cast iron pattern frames, adjustable steel slip flask bars, pattern mountings, etc. One of the features of this exhibit will consist of a four-piece casing, which can be adjusted to molds of any angle; represented by R. S. Buch, W. W. Birnstock, D. C. Coble, H. J. Felsburg, J. E. Buch, J. L. Nute, H. J. Moore, E. P. Pitfield and A. G. Reem.

BUCKEYE PRODUCTS CO., Cincinnati, O.—A complete line of foundry supplies manufactured and sold by this company will be exhibited; represented by C. J. Goehringer, C. S. Weigert, R. B. Ferguson, E. O. Stamm and J. B. Carpenter.

CALUMET FOUNDRY EQUIPMENT CO., Harvey, Ill.—Foundry equipment will be displayed, including ladles, tumbling mills, cupolas, etc.; represented by R. A. Dugan, C. A. Dugan and J. T. Krieger.

CARBORUNDUM CO., Niagara Falls, N. Y.—A complete line of carborundum and aloxite grinding wheels, carborundum and aloxite discs, carborundum rubbing bricks and other abrasives adapted to foundry work will be shown; represented by G. R. Rayner, C. C. Schumaker, O. C. Dobson, J. H. Jackson, R. C. Bradbury and H. E. Kerwin.

CARTER METALS CLEANING CO., Philadelphia.—A sand blast machine for cleaning castings will be shown in operation.

CATARACT REFINING & MFG. CO., Buffalo.—Core oils, cutting oils and cutting compounds will be displayed; represented by R. J. Collins, F. E. Hill, E. P. Hughes and D. L. Baldwin.

CHICAGO PNEUMATIC TOOL CO., Chicago.—Pneumatic tools of various types will be shown, including air drills, grinders, corner drills, sand rammers, riveting and calking hammers; other compressed air-operated equipment will include sand sifters and hoists. A compressor built by this company will be installed to furnish air for operating its equipment; represented by J. G. Osgood, A. C. Andresen, G. W. Parker, A. E. Conrow, C. H. Schumacher and W. C. Walker.

CLARK, CHARLES J., Chicago.—A meter for measuring the volume of cupola blast will be shown in operation and its indication will be compared with that of the ordinary pressure gage; represented by Charles J. Clark.

CLEVELAND PNEUMATIC TOOL CO., Cleveland.—The entire line of pneumatic tools and appliances manufactured by this company will be displayed and chipping hammers, sand rammers, portable emery grinders and other tools adapted to foundry work will be operated. With the exception of riveting hammers, practically all of the tools manufactured by this company are used in foundry work; represented by H. S. Covey, C. J. Albert and Arthur Scott.

CLIPPER BELT LACER CO., Grand Rapids, Mich.—A complete line of belt lacers and supplies will be displayed; represented by W. K. Lee.

COALE, THOMAS E., LUMBER CO., Philadelphia.—A carload of pattern and flask lumber will be displayed, including white pine, spruce, red wood and mahogany. This exhibit will prove a novelty as no display of a similar nature has heretofore been made; represented by Thomas E. Coale.

COWAN TRUCK CO., Holyoke, Mass.—Transveyors used for transporting material in industrial plants will be exhibited and one machine will be shown which has a lifting capacity in excess of 5,000 pounds; represented by E. J. Smith.

CRAWFORD OIL & CHEMICAL CO., Cleveland.—Core oils, match oil, including cores and sand matches made with the use of this material will be shown, as well as waterproofing oil and black paint; represented by George F. Burman, Warner G. Smith and P. S. Crawford,

CURTIS PNEUMATIC MACHINERY CO., St. Louis.—Two electrically-driven air compressors will be operated, one of which will furnish air to the mains for the use of other exhibitors, as well as for the equipment operated in this booth. In addition will be shown a foundry crane equipped with cast steel ends and roller bearing wheels, a closed hopper high pressure sand blast machine, an air hoist and a small trolley system showing details of construction of hangers, switches, cross-overs and trolleys; represented by E. J. Clark and L. C. Blake.

DAVENPORT MACHINE & FOUNDRY CO., Davenport, Ia.—Eight types of molding machines will be exhibited, including a portable jolt rock-over power, pattern-draw machine; a stationary machine of the former type but of larger capacity capable of jolting and rocking-over a half mold weighing 1,500 pounds; three designs of portable and stationary power squeezers; hand rammed roll-over, plain jolt rammer for making cores equipped with a pattern plate 20 inches square and having a capacity of 700 pounds and a small jolt ramming squeezer, 10 x 32 inches; represented by John T. Anderson, Hugh Gallagher and A. J. Goss.

DINGS ELECTRO-MAGNETIC SEPARATOR CO., Milwaukee.—Magnetic separators adapted to separating metal in brass foundries and refining plants, as well as for recovering iron from foundry refuse in steel, malleable and gray iron foundries, will be exhibited; represented by M. Dings and R. A. M. Manegold.

DIXON, JOS., CRUCIBLE CO., Jersey City, N. J.—Crucible and graphite products for brass and steel foundry use will be shown; represented by D. A. Johnson, A. L. Haasis, Frank Krug, John A. Condit, W. B. Allen, F. R. Brandon and H. C. Sorenson.

DOGGETT, STANLEY, New York.—Parting and facing compounds, iron and steel cement, silica wash, soapstone crayons and pencils and dry core compounds will be exhibited; represented by Henry A. Hoffman, Robert Allabach and Stanley Doggett.

DUPLEX SHAKER WORKS, Chicago.—Motor and air-driven sand shakers of three different types will be shown in operation; represented by I. E. Burtis, James Scully and M. K. Ross.

ESSLEY MACHINERY CO., Chicago.—A complete operating exhibit of various types of machine tools built by the following concerns will be made: American Tool Works Co., Cincinnati; Barnes Drill Co., Rockford, Ill.; Cincinnati Pulley Machinery Co., Cincinnati; Diamond Machine Co., Providence, R. I.; Kempsmith Mfg. Co., Milwaukee; International Machine Tool Co., Indianapolis, and the Springfield Machine Tool Co., Springfield, O.

FEDERAL FOUNDRY SUPPLY CO., Cleveland.—This company's exhibit will include a complete coremaking unit, consisting of a jarring machine, air compressor and receiving tank, and two sizes of core jarring machines for bench work, one large floor jolt machine, one large jolt roll-over and direct-draw molding machine. An assortment of pattern plates, match plates and matches made from Federal composition, liquid binder, adjustable slip jackets and a bench snap flask outfit also will be displayed; represented by W. M. Adams, Ralph Ditty, John Bayer and Ellsworth Kaye.

FELT & TARRANT MFG. CO., Chicago.—Demonstrations of the comptometer will be made and new models of this machine will be displayed; represented by R. E. Bell, J. M. Furnas, S. C. Brown and H. F. DeRevere.

THE FOUNDRY, Cleveland.—Represented by John A. Penton, A. O. Backert, W. C. Howe, J. D. Pease, H. Cole Estep, L. C. Pelott, A. L. Klingeman, Fred S. Sly and Tadao Ono.

GARDEN CITY SAND CO., Chicago.—Samples of molding, core and furnace sands, cupola blocks, fire brick, fire clay, sand blast sand, waterproofing compounds, etc., will be shown; represented by C. S. McNeal and William Chambers.

GARDNER GOVERNOR CO., Quincy, Ill.—A line of air compressors for foundry use will be exhibited.

GARDNER MACHINE CO., Beloit, Wis.—Twenty different types and sizes of disc grinding and polishing machines, as well as disc grinder accessories, will be displayed; represented by F. E. Gardner, L. W. Thompson, W. B. Leishman, E. B. Gardner, J. M. Gardner, D. C. Graves, W. L. Townsend and E. L. Beisel.

GENERAL ELECTRIC CO., Schenectady, N. Y.—The centrifugal blowers will be exhibited, including a 30-horsepower induction motor-driven machine, with a capacity for delivering 3,200 cubic feet of free air per minute against 16 ounces pressure, and one 20-horsepower Curtis turbine-driven machine, with a capacity for delivering 3,200 cubic feet of air per minute, against 16 ounces pressure. One of the features of the operation of this apparatus particularly desirable in cupola work is the extreme steadiness of the blast. The steady melting of iron and the uniform descent of the charges in the cupola are dependent on the maintenance of uniform conditions of air pressure, because the charge in the cupola, to some extent, is supported by the pressure of the blast, and if this varies the charge is liable to descend irregularly, causing unsatisfactory melting conditions.

GILL CLAY POT CO., Muncie, Ind.—Fire clay products, such as brass furnace linings, caps, stops, cupola blocks, etc., will be shown;

NIX! GET OFF YOUR FOOT! WHAT DO YOU THINK I AM? THOSE GUYS CAN'T TEACH ME NOTHIN'—
HOOPLA! "HEN" OLD BOY, GOING TO THE CONVENTION WITH ME?
1 "BILL" TRIES TO INDUCE HENRY TO GO TO THE CONVENTION
THERE'S SOMETHING ELSE— WILL SAVE US TIME AND MONEY— I MUST INVESTIGATE AT ONCE!
5 "BILL" HUSTLES AROUND FOR INFORMATION.
I WONDER WHY HENRY DIDN'T COME? LOT OF THINGS AROUND HERE WOULD HELP HIM. I SEE "BILL", FOREMAN OF "UP-TO-DATES" OVER THERE— HE'S GETTING WISE TO A LOT OF NEW IDEAS—
HENRY'S BOSS
2 HENRY'S BOSS LOOKS FOR HENRY BUT FINDS "BILL"
?
HENRY, I'VE JUST BEEN DOWN TO THE CONVENTION AND EXHIBITION AND HAVE HAD MY EYES OPENED— YOU'RE ABOUT 400 YEARS BEHIND THE TIMES— YOU'RE FIRED!
6 HENRY GETS FIRED
HELLO "BILL", TICKLED TO DEATH TO SEE YOU HERE I DIDN'T TELL YOU TO COME BECAUSE I WANTED TO SEE WHAT KIND OF STUFF YOU'RE MADE OF
BILL'S BOSS
3 "BILL'S" BOSS FINDS THAT "BILL" IS UP-TO-DATE AND PROGRESSIVE
CONGRATULATIONS, "BILL" OLD BOY, I SEE YOU'VE ALREADY INSTALLED THOSE NEW CONVENTION IDEAS. WE'RE GOING TO TAKE YOU INTO THE COMPANY AT THE NEXT BIG MEETING!
7 "BILL" GETS PROMOTED
THIS IS LOTS BETTER THAN GOING TO CONVENTIONS— AND EXHIBITIONS
4 HENRY STAYS AT HOME AND TAKES IT EASY
"HENRY"
"BILL"
"FINIS"
8

"BILL" ATTENDED THE FOUNDRYMEN'S CONVENTION AND EXHIBITION, BUT "HENRY" STAYED AT HOME

represented by Charles O. Grafton and John H. Gill.

GLOBE STEEL CO., Mansfield, O.—A complete line of samples of shot for cleaning castings will be exhibited and samples of forgings, gray iron, malleable iron and steel castings cleaned with this shot also will be displayed; represented by P. G. Myers.

GOLDSCHMIDT THERMIT CO., New York.—Demonstrations of welding will be made daily and in addition thermit cans for reviving dull iron in the ladle and making thermit steel, anti-piping cans for preventing piping in steel ingots and the use of thermit for general repair work, will be shown. Various metals and alloys produced free from carbon by the thermit process, including ferro-titanium, manganese, chromium, ferro-chromium, cobalt, manganese-copper and manganese-titanium, also will be displayed; represented by H. S. Mann, E. A. Beck, D. B. Browne and A. F. Braid.

GOODALE CO., Kalamazoo, Mich.—Several complete stoves will be exhibited, the castings for which were molded from match-plates made by the Goodale Co. Floor plates, hinged and fitted with flasks, and a number of machine or bench plates with flasks also will be shown, as well as a wide assortment of castings, including plumbers' brass goods, agricultural implements, gun parts, stove plate, etc., made by the use of Goodale match-plates; represented by J. Goodale, W. C. Bogenschutz and H. C. Howard.

GREAT WESTERN MFG. CO., Leavenworth, Kas.—Gyratory foundry riddles, both electrically and air-driven, will be exhibited; represented by Geo. W. Combs and F. A. Picsett.

GREAT WESTERN SMELTING & REFINING CO., Chicago.—Ingot brass, bronze, etc., and brass and bronze castings made from various ingot compositions, as well as babbitt and pig metals, will be shown; represented by J. N. Perlstein, A. L. Levy, Arthur Lewis and J. H. Collins.

HANNIFIN MFG. CO., Chicago.—A line of pneumatic tools for foundry use will be shown.

HAYWARD CO., New York City.—A new electrically-operated clam-shell bucket for foundry use will be displayed.

HERMAN PNEUMATIC MACHINE CO., Zelienople, Pa.—The molding machines and other equipment that will be exhibited by this company include the following: A new design of jar-ramming independent roll-over and pattern-drawing machine, which will be operated; a jar-ramming stripping-plate machine equipped with hand pattern-drawing device; jar-ramming core machines and a number of large sizes of jarring machines in addition to a new type of vibrating sand sifter; represented by A. M. Frauenheim, H. L. Heyl, A. Rodgers, A. Herman, Lewis H. Palmer and Robert F. Ringle.

HILL-BRUNNER FOUNDRY SUPPLY CO., Cincinnati.—A display will be made of samples of graphite, plumbago and foundry facings, as well as other foundry supplies; represented by John Hill and M. Z. Fox.

HILL & GRIFFITH CO., Cincinnati.—A complete line of chaplets and foundry specialties will be displayed; represented by D. T. Richards, Wm. Oberhelman, J. M. Glass, Jas. A. Carey, F. W. Weissmann, George H. Kersting, J. H. Lyle and F. McCarthy.

HOEVEL SAND BLAST MACHINE CO., New York.—Several dustless, self-contained sand blast machines will be shown in operation and the Wiener Machinery Co. also will display a triple combination punch, shear and bar and angle cutter; represented by George A. Cooley, Jesse J. Bowen, R. B. Franken, Ernst Wiese, George J. Ballweber and F. H. Scantlebury.

HOSKINS MFG. CO., Detroit.—Two electric furnaces for heat-treating carbon and high speed steels will be shown in operation and daily demonstrations will be made of tool hardening. In addition, pyrometers, electric furnaces, hot plates, voltmeters and ammeters will be shown; represented by C. F. Busse, W. D. Little and A. B. Tilton.

HUNTER SAW & MACHINE CO., Pittsburgh.—The equipment that will be shown by this company will include a machine for grinding teeth of inserted-tooth saws, a saw grinder and beveling machine; 21-inch, 26-inch, 30-inch, 36-inch and 40-inch diameter inserted-tooth saw; 24-inch saw for cutting hot tubes; 36-inch saw for cutting hot ingots and forgings; a 44-inch vanadium steel, high speed friction saw for cutting rails, structural shapes, bar iron, steel, etc., and an extensive line of saws for various types of metal cutting machines; represented by F. A. Hunter and G. W. Agerter.

IDEAL FURNACE CO., Chester, Pa.—A tilting crucible furnace for melting iron, copper, brass, bronze, aluminum, etc., will be exhibited; represented by P. J. Sweeney.

INDEPENDENT PNEUMATIC TOOL CO., Chicago.—The equipment that will be shown by this company will include a new single valve pneumatic chipping, calking and flue-bending hammer, designed especially for iron and steel foundry service; pneumatic sand rammers, electric drills, one piece pneumatic long stroke riveting hammers, center spindle and close-quarter piston air drills, wood boring machines and a pneumatic grinder particularly adapted for foundry use; represented by J. D. Hurley, R. T. Scott, George C. Wilson, B. A. Durbin, Fred J. Passino and W. R. Gummers.

INGERSOLL-RAND CO., New York.—A complete line of pneumatic tools for foundry use will be shown, including sand rammers, pneumatic chipping hammers, pneumatic piston drills, pneumatic motor hoists and stationary motors. Two motor-driven air compressors will be operated for furnishing air to the other exhibitors. One will supply air at 100 pounds pressure and the other at 50 pounds pressure; represented by W. H. Armstrong, W. A. Armstrong, James Moran, J. L. Kelly, Lloyd J. David, James P. Gillies, Grover C. Lucker, John D. Rathbun and C. W. Bugbee.

INTERNATIONAL MOLDING MACHINE CO., Chicago.—The molding machines to be displayed by this company will include power squeezers, with 9-inch, 10-inch and 13-inch cylinders; two stripping plate machines, for small and large heavy work, respectively; jarring machines operated by air and electricity and one special machine for making cores; one 22 x 20-inch and 8-inch draw, hand turn-over draw machine and a special machine of this type for making cores; one 30-inch, 8-inch cylinder and 12-inch draw, turn-over; power turn-over, power draft machine and the following combination machines: Air jar-ramming, hand turn-over draw, electric jar-ramming, hand turn-over draw, air jar-ramming, power turn-over, power draw and one stripping plate squeezer; represented by Edward A. Pridmore, W. W. Miller, J. W. Dopp, E. H. Schwartz and D. C. Snow.

INTERSTATE SAND CO., Zanesville, O.—Various grades of molding sands and clays for foundry use will be shown; represented by F. L. Moore.

The Iron Trade Review, Cleveland.—Represented by John A. Penton, A. O. Backert, W. C. Howe, J. D. Pease, H. Cole Estep, L. C. Pelott, A. L. Klingeman, Fred S. Sly and Tadao Ono.

JENNISON-WRIGHT CO., Toledo.—"Kreolite" blocks in the form of sections of floors for foundries, machine shops, casting cleaning and stock rooms will be shown, as well as blocks adapted to different kinds of factory floor work. The method of attaching machinery to these floors also will be demonstrated; represented by F. E. Jennison and F. M. Enwright.

KAWIN, CHARLES C., CO., Chicago.—This firm of chemists and metallurgists will be represented by Charles C. Kawin, J. F. Nellis, R. J. Courtney, William J. Mulcahy and J. H. Hopp.

KELLY, T. P., & CO., New York.—The space reserved by this company will be furnished as an office and rest room; represented by Walter F. Kaine Jr. and Edwin R. Wolverton.

KING, JULIUS, OPTICAL CO., New York City.—Goggles for protecting the eyes of foundry operators will be exhibited; represented by J. T. Brayton and J. J. Duffy.

KNICKERBOCKER CO., Jackson, Mich.—A Morse rarefied dust collector built by this company will be shown. This collector is installed between the source of dust and the fan, thereby separating the dust from the air before the latter reaches the fan; represented by W. B. Knickerbocker.

LUPTON, DAVID, SONS CO., Philadelphia.—Equipment for lighting and ventilating foundries and other industrial plants and designs for special roof formations will be shown. A large number of photographs also will be displayed, showing the installation of Lupton products; represented by Clark P. Pond and R. A. Sanborn.

McCORMICK, J. S., CO., Pittsburgh.—This exhibit will consist of a facing and core sand mixer, pistol sprayer, cupola lighter, foundry supplies, blacking and a general line of facings; represented by J. S. McCormick, T. E. Malone and S. R. Costley.

McLAIN'S SYSTEM, Milwaukee.—This exhibit will consist of semi-steel castings of light section, such as automobile cylinders, test bars, etc., containing 30 per cent steel; represented by David McLain, I. V. Scanlan, Harry McLain and C. W. Miller.

MACLEOD CO., Cincinnati.—This company will exhibit a 4,000-pound capacity sand blast machine, sand separator, oil burners for lighting cupolas and skin-drying molds and an oxy-acetylene plant for welding and cutting; represented by Walter Macleod, J. W. Mooney and Fred Neumann.

MANUFACTURERS EQUIPMENT CO., Chicago.—Chucks and collapsible taps will be shown; represented by Charles George and Paul J. Grebel.

MARSHALL & HUSCHART MACHINERY CO., Chicago.—Practically the entire machine tool exhibit that will be made by this company will be operated. The machines that will be shown, with the names of the builders follow: Baker Bros., Toledo, O., high speed drill and key seater; Acme Machine Tool Co., Cincinnati, flat turret lathe and an 18-inch universal turret lathe; Willard Machine & Tool Co., Cincinnati, 13-inch gap lathe and 13-inch tool room lathe; Greaves, Klusman & Co., Cincinnati, 15-inch standard heavy pattern engine lathe and a 17-inch standard heavy pattern engine lathe with geared head; Gould & Eberhardt, Newark, N. J., 28-inch shaper with variable speed motor drive and a 12 x 6-inch gear hobber; Rockford Drilling Machine Co., Rockford, Ill., 23-inch heavy duty gang drill; Landis Machine Co., Waynesboro, Pa., 1½-inch double head bolt cutter; Cincinnati Planer Co., Cincinnati, 36 x 36-inch x 8-foot heavy pattern planer with reversible motor drive; Lodge & Shipley Machine Tool Co., Cincinnati, 16-inch x 6-foot tool room lathe and 18-inch x 8-foot selective head lathe; Cincinnati Bickford Tool Co., Cincinnati, 4-foot plain radial drill with variable speed motor and a 24-inch shaft-driven drill

press; Bullard Machine Tool Co., Bridgeport, Conn., 36-inch vertical turret lathe with water attachment; Cincinnati Milling Machine Co., Cincinnati, vertical and universal milling machines and a universal cutter and reamer grinder. Other equipment that will be displayed will include a LaSalle surface grinder and Partridge grinders.

MIDLAND MACHINE CO., DETROIT.—This operating exhibit will consist of a power jar-ramming roll-over molding machine, the Grimes hand-rammed roll-over molding machine and a new method of mounting patterns will be demonstrated; represented by G. L. Grimes and Charles Skeffington.

MONARCH ENGINEERING & MFG. CO., Baltimore.—An extensive display of melting and heating furnaces will be made, including the following types: Tilting iron pot for soft metals, tilting foundry coke-fired, tilting oil-fired, tilting gas-fired, stationary oil or gas drop-bottom pit furnaces, stationary oil or gas foundry furnaces, portable car type tilting furnace for melting metals, combination triple shop furnaces for tool rooms, combination 8 in 1 furnaces for tool rooms, oil rivet and blacksmith forges, ladle heaters, core ovens, lead hardening and melting furnaces, etc.; represented by H. D. Harvey, James H. Fowler, M. W. Woodburn and James J. Allen.

MOTT SAND BLAST MFG. CO., Chicago.—This exhibit will be made in conjunction with that of this company's eastern branch, the De La Vergne Machine Co., New York City. A dustless sand blast will be shown in operation and a model sand blast room, completely equipped, will be exhibited; a hose sand blast machine also will be shown; represented by David Mayer and E. J. Rosenthal.

NEW HAVEN SAND BLAST CO., New Haven, Conn.—A self-contained sand blast barrel will be shown in operation, and a new automatic hose type machine for cleaning large work also will be displayed; represented by Chas. A. Dreisbach and Chas. S. Johnson.

NORMA CO. OF AMERICA, New York.—Precision ball and roller bearings will be exhibited; represented by Walter M. Nones and George R. Bott.

NORTON CO., Worcester, Mass.—Demonstrations will be made of swing frame grinding machines, flexible shaft grinding machine, new model 2-inch floor stand grinder, new model ¾-inch bench grinder and alundum and crystolon grinding wheels used in foundry work also will be shown. To illustrate alundum muffles and pyrometers a Hoskins furnace also will be operated; represented by E. W. Dodge, Carl F. Dietz, John Horne, C. E. Gillette and R. G. Williams.

OBERMAYER, S., CO.—A complete line of foundry equipment and supplies will be exhibited, including the Todd rumbler, rosin grinder, core ovens, sand drying stove, sprue cutter, ladle shanks, sand sifters, molders' tools, core and molding benches, molding trough, core venting machine, chaplets, brushes, riddles, flasks and flask trimmings, rapping plates, dowel pins, leather and wood fillets, shovels, flask clamps, facings, graphites, parting and core compounds, core binders, oils, etc. In addition, the following companies will exhibit in this booth: Emmert Mfg. Co., Waynesboro, Pa., complete line of vises for pattern shop use; Blake & Knowles Steam Pump Co., New York City, core wire straightening machines and wire cutters; P. H. & F. M. Roots Co., Connersville, Ind., positive pressure blowers for foundry use; Ransom Mfg. Co., Oshkosh, Wis., emery grinders, and the Hauck Mfg. Co., Brooklyn, N. Y., fuel oil torches for lighting cupolas, drying molds, cores, etc. Represented by Theodore Kauffman, president; E. D. Frohman, S. T. Johnston, C. H. Green, J. J. McDevitt, J. E. Evans, O. J. Peterson, C. M. Barker, F. H. Dodge, W. Fitzpatrick, O. C. Olson, A. N. Wallin and G. P. Peterson.

OHIO SAND CO., Conneaut, O.—Samples of various grades of molding sand will be displayed; represented by F. E. Gordon and U. E. Canavel.

OLIVER MACHINERY CO., Grand Rapids, Mich.—Pattern shop and wood-working machinery will be shown in operation, including a universal milling machine, two types of gap lathes, two types of boring machines, two types of motor-driven lathes, universal sander, double disc sander, universal saw bench, surfacer, two types of jointers, combination patternmakers' lathe, motor-driven band saw, universal grinder and a complete set of filing room tools; represented by G. F. Reinhard, J. W. Oliver, V. M. Tuthill, M. D. Baldwin, W. Y. Mintzer, A. Blake, A. S. Kurkjian and J. C. Whitney.

OSBORN MFG. CO., Cleveland.—An extensive operating exhibit of molding machines will be made, including plain jolt ramming, direct draw roll-over jolt rammers, drop plate and stripping plate machines, air squeezer and drop plate flask-stripping squeezer machines, direct draw roll-over machines, roll-over rock-down and rock-over drop-draft machines; represented by H. R. Atwater, E. S. Carman, J. H. Galloway, E. F. Streich, W. M. Zeman, E. T. Doddridge and J. A. Patterson.

OXWELD ACETYLENE CO., Chicago.—An operating exhibit of oxy-acetylene welding apparatus as applied to foundry work for cutting risers, shrink-heads, etc., from castings will be made; represented by H. P. Harding, W. S. Hoyt, C. H. Dockson, J. A. Warfel, W. H. Yetman, E. E. Radcliffe, J. H. Williamson, J. V. Upton, G. M. Bailey, J. R. Wilson, Karl Byington, W. H. Johnson and C. R. Sutton.

PANGBORN CORPORATION, Hagerstown, Md.—Equipment for cleaning castings by the sand blast process will be shown in operation, including a hose type machine and a sand blast tumbling barrel. In addition, a sand separator, sand dryer, air and moisture separator and a special sand blast car will be exhibited; represented by Thomas W. Pangborn, John C. Pangborn, H. D. Gates and Foster J. Hull.

PAWLING & HARNISCHFEGER CO., Milwaukee.—A new type crane trolley, a 3-ton hoist, and a ¾-yard bucket in operation on a special structural frame will be displayed in addition to I-beam trolleys, motors and controllers; represented by A. G. Hendricks, Arthur Fritsch, R. A. S. Johnson and Bruno Fritsch.

PAXSON, J. W., CO., Philadelphia.—Sand blast machines, tilting sand blast tumbling barrels, hand cleaning machines and a suction elevator and separator will be shown in operation. A large number of blue prints and photographs of recent sand blast installations also will be displayed; represented by Howard M. Bougher, W. S. Thomas and I. F. Kremer.

PEERLESS PARTING CO., Ottawa, Ill.—Samples of parting manufactured by this company will be displayed and the booth will be fitted up as an office and rest room; represented by C. A. Hupp.

PENNSYLVANIA STEEL CO., Philadelphia.—Samples of Mayari pig iron will be displayed; represented by F. P. Bassett and Robert Gross.

PETERSON-NATIONAL CO., Chicago.—Samples of this company's products, including core oil, dry core compound and parting will be displayed, and cores made with this compound and oil, obtained from numerous large foundries, also will be shown. One of the interesting features of this exhibit will be an electrically-operated core oven, which will be operated; represented by James A. Drake, John Purvis, R. W. Bull, H. S. Peterson, G. W. Doty, James Johansen and Myles Monahan.

PICKANDS, BROWN & CO., Chicago.—The display of by-product coke to be made by this company will be in conjunction with that of Baird & West, Detroit. It will consist of a replica of the rock of Gibraltar built from coke; represented by J. A. Galligan, B. T. Bacon, G. A. T. Long, Frank T. Lovering, Thomas W. Glasscot, E. A. Bateman, R. S. Dutton, C. L. Miner and F. L. Schulze.

PREST-O-LITE CO., INC., Indianapolis.—Two complete oxy-acetylene welding outfits will be displayed, equipped with 100-cubic-foot and 300-cubic-foot cylinders and samples of welding by these machines also will be shown. One of these welding machines will be operated and demonstrations will be made daily; represented by George D. Armstrong, E. J. Rork, W. H. Adkinson, and L. L. Sinclair.

PRIDMORE, HENRY E., Chicago.—Practically all of the machines comprising the extensive line manufactured by this company will be operated, including stripping plate machines, rock-over drop molding machines, power squeezers, plain electric-driven jarring machines, combination electric jolt rock-over drop molding machines, electric jolt stripping plate machines, power-ramming stripping plate machines and hand squeeze stripping plate molding machines; represented by Mrs. E. M. Pridmore, H. A. Pridmore, A. V. Magnuson, T. J. Magnuson, D. F. Eagan, C. H. Ellis and Arthur Leidig.

QUIGLEY FURNACE & FOUNDRY CO., New York City.—A continuous baking core oven will be shown and photographs of furnaces and powdered coal burning equipment will be displayed; represented by W. S. Quigley, Paul Ramp, William Brewster, H. B. Dempsey and A. W. Moyer.

QUITMAN FOUNDRY & MACHINE CO., Quitman, Ga.—Two permanent mold casting machines equipped to produce car journal bearings will be shown. These machines are adapted to the production of articles in ferrous and non-ferrous metals in which rods, chaplets and dry sand cores are inserted into the mold cavity; represented by W. W. McCarter.

RACINE TOOL & MACHINE CO., Racine, Wis.—Motor-driven, high speed metal cutting machines of three different types; represented by J. M. Jones.

ROBESON PROCESS CO., Pennington, N. J.—Samples of "Glutrin" for core mixtures will be displayed; represented by D. S. Robeson, W. E. Baird and T. J. Ryan.

ROBINSON, WM. V., CO., Owosso, Mich.—Machines adapted to polishing flat and oval castings, such as stove parts, sad irons, registers, etc., will be shown in operation; represented by Wm. V. Robinson, George Valentine.

ROCK ISLAND MFG. CO., Rock Island, Ill.—Machinists' and patternmakers' vises will be displayed.

ROGERS, BROWN & CO., Cincinnati.—The moving pictures entitled "From Mine to Molder", which proved one of the most attractive features of the Buffalo exhibit, will be displayed in an auditorium in the south straightaway building. The pictures will be shown five times daily throughout the exhibition period and the auditorium will have a seating capacity of approximately 500. In addition, this company has reserved a space in the arena where an extensive line of pig iron, coke, ferro-manganese and fluorspar will be displayed; represented by M. Cochrane Armour, E. L. Billingslea, Henry B. B. Yergason, C. A. Stillman, F. I. Foote, C. E. Bertie, L. C. Calkins, A. B. Weaver, A. O. Sonne, H. S. Smith, E. L. Ives, Wm. S. Rogers, F. J. Waldo, Wm. P. Cheney, S. W. Hubbard,

O. Arlt, R. W. Clark, J. C. Mears, F. W. Bauer, R. D. Meacham, Edwin Raum, Perrin Rule and C. J. Olson.

SAND MIXING MACHINE CO., New York City.—A new design of self-propelled sand cutting machine and a new type of sand cutting machine for use in heavy machinery foundries, jobbing shops, steel and malleable foundries will be shown in operation. The latter machine is suspended from a bridge crane; represented by V. E. Minnich, W. A. Heartt, Hutton H. Haley, John Bradley and C. H. Benham.

SELLERS, WILLIAM, & CO., Inc., Philadelphia.—The equipment to be shown will include centrifugal sand mixing machines, both belt and motor-driven, a drill grinding machine, motor-driven, and a universal tool grinding and shaping machine; represented by Edward L. Holljes.

SHEPARD ELECTRIC CRANE & HOIST CO., Montour Falls, N. Y.—The handling and conveying equipment to be shown by this company will include a two-motor, pulpit-controlled electric traveling hoist, an overhead electric traveling crane trolley having a capacity of 10 tons and a cage-controlled, overhead electric traveling monorail hoist; represented by F. A. Hatch, R. H. McGredy, W. B. Briggs and N. Prakken.

SILICA PRODUCTS CO., Chicago.—A new facing and wash to facilitate the production of clean castings is being manufactured by this company, and the results obtained will be shown in the form of castings which have been removed from the sand without further cleaning. A fluxing compound and scavenger also will be displayed which, when introduced in the cupola or added to the molten metal in the ladle, will decrease the sulphur and phosphorus in the iron or steel, and it is claimed will increase the strength and decrease shrinkage.

SLY, W. W., MFG. CO., Cleveland.—A complete sand blast cleaning mill outfit will be exhibited, as well as a large number of photographs of this company's cleaning room equipment; represented by W. C. Sly, George J. Fanner, P. W. Graue and T. J. Morgan.

SMITH, R. P., & SONS CO., Chicago.—Safety congress shoes for molders will be shown; represented by J. B. Smith Jr.

SNEAD & CO. IRON WORKS, Jersey City, N. J.—An 8-foot x 30-inch MacDonald roller-ramming molding and pattern-drawing machine will be operated, making patterns from match plates containing eight radiator sections, three sections of stove pipe and a large ornamental casting. To handle the sand when making the molds, a special dumping box will be utilized, which eliminates hand shoveling; represented by H. P. MacDonald, W. E. Martin, P. W. Jordan and Ira S. Snead.

STANDARD SAND & MACHINE CO., Cleveland.—A complete line of sand mixing, tempering and conveying machinery will be exhibited, including five sizes of batch mixers, a centrifugal pulverizer; a mixing, rolling and bonding machine; charging hoppers, elevator boots and bucket and chain elevators. Samples of molding sand for all classes of foundry work also will be shown; represented by H. G. Boughton, J. A. Boughton, H. E. Boughton, J. L. Hopper, F. S. Scoville and R. S. Hoffman.

STERLING WHEELBARROW CO., West Allis, Wis.—Rolled steel foundry flasks, wheelbarrows, skim gates, gate sticks, snap flasks and foundry wedges will be exhibited; represented by I. R. Smith, H. H. Baker, J. J. Coyne, E. W. Dowd and G. H. Lambkin.

STEVENS, FREDERIC B., Detroit.—A complete line of foundry facings, plumbago, core wash and polishers' and platers' supplies will be shown; represented by Frederic B. Stevens, James F. Hughes, Joseph M. Johnston, A. T. Wagner and David D. Baxter.

SUPERIOR SAND CO., Cleveland.—Samples of a complete line of molding sands for the production of aluminum, brass, gray iron and malleable castings, as well as special sands for car wheel and heavy machinery work, will be shown; represented by W. H. Smith and H. C. Koontz.

TABOR MFG. CO., Philadelphia.—None of the extensive line of molding machines built by this company will be exhibited, but an unusually attractive display of mounted photographs will be made, showing all sizes and types of Tabor molding machines and the results obtained by their use in various foundries throughout the country; represented by Wilfred Lewis, H. W. Brown, J. T. Ramsden, J. C. Coleman, Dudley Willcox, G. B. Hastings, D. J. Martin and H. W. Impey.

TITANIUM ALLOY MFG. CO., Niagara Falls, N. Y.—Special titanium products for the treatment of iron and steel and non-ferrous metals will be shown; represented by H. H. Cook and Charles Vickers.

UNITED STATES GRAPHITE CO., Saginaw, Mich.—The space reserved by this company will be equipped with chairs, desks, etc., for the accommodation of visitors, but no display will be made of the extensive line of United States graphite products; represented by H. C. Woodruff, J. G. Drought, F. B. Goddard, Mr. Williams and Mr. Webb.

U. S. MOLDING MACHINE CO., Cleveland.—A large number of the machines that will be displayed by this company will be operated and the exhibit will include a plain air squeezer; combination jar-ram, squeeze, pattern-drawing machine; 3-inch, 4-inch and 8-inch plain jar molding machines; 8-inch combination jar-ram pattern-drawing machine, combination jar-ram, roll-over, pattern-drawing machine; vibrators, etc.; represented by J. N. Battenfeld.

VULCAN ENGINEERING SALES CO., Chicago.—The extensive line of molding machines manufactured by the Mumford Molding Machine Co. will be shown in operation, including various types of jolt rammers, both air and electrically-operated, plain power squeezers, split pattern vibrator machines, etc., as well as pneumatic vibrators. The Q. M. S. Co. will exhibit metal saws, cranes, hoists and trolleys and the Hanna Engineering Works will make a display of screen shakers, dumping riddles and mold dryers; represented by E. H. Mumford, James T. Lee, J. T. Georgeson, W. H. Huelster, Carl Falk, A. B. Caleen, David M. Whyte and T. J. Mumford.

WADSWORTH CORE MACHINE & EQUIPMENT CO., Akron, O.—The core room equipment that will be exhibited by this company includes the following: Two sizes of core machines mounted on iron tables and legs, two sizes of core cutting-off and coning machines also mounted on iron tables and legs, jar-ramming coremaking machine, sand mixing and compound mill, core testing machine, core oven and sample cores made on the coremaking machines built by this company; represented by George H. Wadsworth and M. C. Sammons.

WEBB, J. F., MFG. & SUPPLY CO., Davenport, Ia.—Two pneumatic power ramming molding machines will be shown in operation; represented by J. F. Webb.

WEST HAVEN MFG. CO., West Haven, Conn.—Lathe tools of various kinds will be displayed.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa.—Represented by R. H. Moore, D. A. Moran and A. L. Hampton.

WHITING FOUNDRY EQUIPMENT CO., Harvey, Ill.—The equipment to be exhibited will include a two-ton steel converter and tilting mechanism which is operated by a motor; 6,000-pound tea pot spout ladle, two-motor electric crane trolley operating a 1½-cubic yard quick detachable grab bucket, a section of drawer type core oven and an exhaust tumbling barrel. Photographs also will be displayed of installations of this company's equipment and blue prints will be available, showing lay-outs of recently complete foundry plants, etc.; represented by C. A. Hardy, P. A. Dratz, R. E. Prussing and R. H. Bourne.

WILLSON, T. A., & CO., INC., Reading, Pa.—A new eye protector will be shown by this company designed for use by chippers and other foundry employes. The new style glass combines new features of comfort, adaptability and protection. In addition, other goggles, eye glasses, etc., will be displayed; represented by Frederick Willson, Harold W. Davie and Benjamin T. Roberts.

WILMARTH & MORMAN CO., Grand Rapids, Mich.—A motor-driven wet surface grinding machine will be shown in operation and other equipment will include a motor-driven drill grinder and double end drill grinder with a drill holder for grinding large drills on one end and small drills on the other, and a combination cutter, reamer and drill grinder; represented by E. T. Gorham and H. L. Saunders.

WOODISON, E. J., CO., Detroit.—The booth of this company will be fitted up as an office; represented by E. J. Woodison, E. B. Fleury, R. H. Mills, M. A. Bell and J. A. Disney.

WRIGHT MFG. CO., Lisbon, O.—A complete line of high speed hoists, screw chain hoists and plain and geared trolleys will be shown; represented by H. H. Wright, C. F. Wright, F. W. Henderson and R. C. Blair.

WYOMING SHOVEL WORKS, Wyoming, Pa.—A complete line of foundry and molders' shovels will be shown, as well as an extensive line of shovels for other work; represented by G. E. Geer.

Get Your Mail at THE FOUNDRY Booth

For the convenience of the large number of foundrymen who will be in Chicago during Founders' week, in attendance at the exposition of foundry equipment and supplies and the meetings of the American Foundrymen's Association, American Institute of Metals and the Associated Foundry Foremen, THE FOUNDRY *has made arrangements to distribute all mail, addressed in its care, from* THE FOUNDRY *booth in the International Amphitheater.*

Exhibitors and their representatives also are invited to take advantage of this service, which will greatly facilitate the prompt delivery of mail, particularly to those who at present are undecided as to their temporary address while in Chicago.

Have your mail sent in care of THE FOUNDRY, *International Amphitheater, Forty-second and Halsted streets, Chicago.*

This Number of THE FOUNDRY—What It Means to You

THAT the foundry trade ranks with the leading industries of the country is reflected by this number of THE FOUNDRY, which is the largest and most complete publication of its kind ever issued. Every page records the recent wonderful progress made in the art of casting metals and the large number of labor-saving devices illustrated and described indicates that the foundryman has equipment available that will enable him to effect economies as great as those introduced by any other branch of manufacture.

For many years the trade was slow to adopt new methods, but in the last decade unparalleled advances in practice have been made.

To the ingenuity, foresight and persistence of the manufacturers of foundry equipment, the progress recorded in foundry work in recent years, in large measure, must be attributed. They studied the foundrymen's needs and devised tools and machines to meet their most exacting requirements. In a comparatively limited number of years the attitude of the producers of castings has veered completely from the closed door policy and they now meet with open mind every proposition for the purchase of equipment that will result in reducing the cost of manufacture.

The diversity of products advertised in this issue of THE FOUNDRY is the best barometer of the wonderful forward strides that are being made by the industry. They constitute a convincing argument in proof of the position of preeminence now occupied by the trade and indicate that it has emerged from a state of somnolency to one of great activity in effecting economies in operating costs.

The advertising section of this number of THE FOUNDRY constitutes the most complete catalog of foundry supplies and equipment that has ever been compiled.

Pointing the way to some saving that you can introduce in your shop, every page merits your careful and earnest perusal.

Regardless of the size of your plant, you have been an important factor in elevating the foundry industry to the position of importance it occupies today.

To you, and to thousands of others engaged in a similar line of work, has been entrusted the future advancement of the trade, and continued progress can be maintained only by co-operation with the manufacturers of foundry supplies and equipment.

In this issue of THE FOUNDRY they have laid before you, for your selection, a magnificent array of labor-saving devices. These have been spread in generous proportion over more than two hundred pages and reflect a measure of support of your industry that must invite your deep consideration and respect.

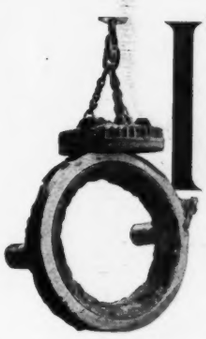
Foster the spirit of co-operation that prompts the equipment manufacturers to spare no expense in designing tools for your needs.

Encourage them in their great work in your behalf with solicitous inquiries for further details and *credit to THE FOUNDRY the source of your information* concerning their products.

Application of Electric Power in the Foundry

How the Use of Motor-Driven Equipment Effects Economies in Casting Plants, With Side Lights on the Adaptability of the Lifting Magnet

By H F Stratton



IF, IN different industries, one undertakes to dissect and pick out the various contributing reasons which, blended, make profitable the use of electric power, he finds certain of these basic reasons in each different case. It is true, that in any particular branch of manufacture, one of these contributing causes may become very important, or even predominant. For instance, in the business of rolling steel products, probably the most important element of performance with which electric power must be credited, is speed of production, whereas such features as power economy, betterment of illumination, and freedom of fire hazard—all very much worth while in certain industries, as in cotton mills—are relatively unimportant in the steel mill, and in themselves have done little to accelerate the use of the electric motor in this industry. It is probably true that if a correct analysis can be made of the arguments, *pro* and *con*, relating to the use of electric power in most businesses, it will be found that conclusions based on this analysis do not differ materially from actual existing practice. Immediately, however, it should be stated that sometimes, and unfortunately, artificial or negative reasons delay the normal growth of the use of electric power. Such a reason may be the poor financial condition of even a large industry, where the manager cannot see his way clear to install new machinery, even though its installation will, without doubt, yield a return upon the investment proportionately, many times, in excess of the return which he is securing upon his old equipment. Another such case, and one quite frequent, arises from the fact that a business may be old and steeped in tradition and conservatism.

The sequence of evolution of an industry is that repeated thought or action grows to habit, habit to inherited habit, and inherited habit to instinct. Such an industry, guided largely in its policies by instinct and tradition, unless goaded by some unusual and peculiar stimulus, will be constantly behind the normal use of modern and economical processes and devices. May it not be true that the foundry business, which is the oldest of the important commercial metallurgical arts, is suffering from too much tradition and conservatism? Is it not also true, and possibly as a related fact, that of all the basic, big, metal industries, the iron foundry has been, during the last 10 or 20 years, the most disintegrated and the least profitable?

Much misapprehension can, and does, exist concerning the precise reasons by which the electric motor has been of such conspicuous financial benefit in its diversified applications. By limiting this very pertinent question to the industries immediately concerned with the production and manufacture of iron and steel products, it can be assumed that the one overwhelmingly important contribution of electric power, has been to magnify production enormously without increasing manufacturing equipment, or labor charges, in anything like the same ratio. Even in the electrical profession itself, much vagueness frequently exists as to the relative merits of the different arguments in support of electric power. All too often we find both the sellers and the buyers of electrical equipment much concerned over the question of a few dollars of extra cost for power or machinery, and overlooking the enormously vital consideration of what effect this contemplated new

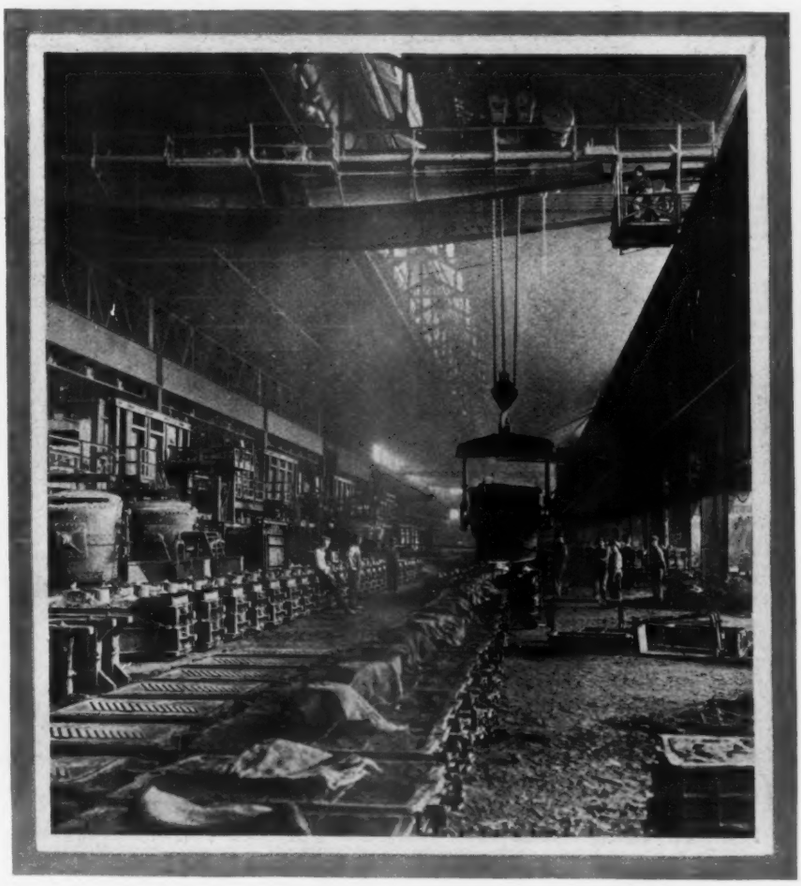


FIG. 1—POURING STEEL CASTINGS FROM A LARGE BOTTOM-POUR LADLE

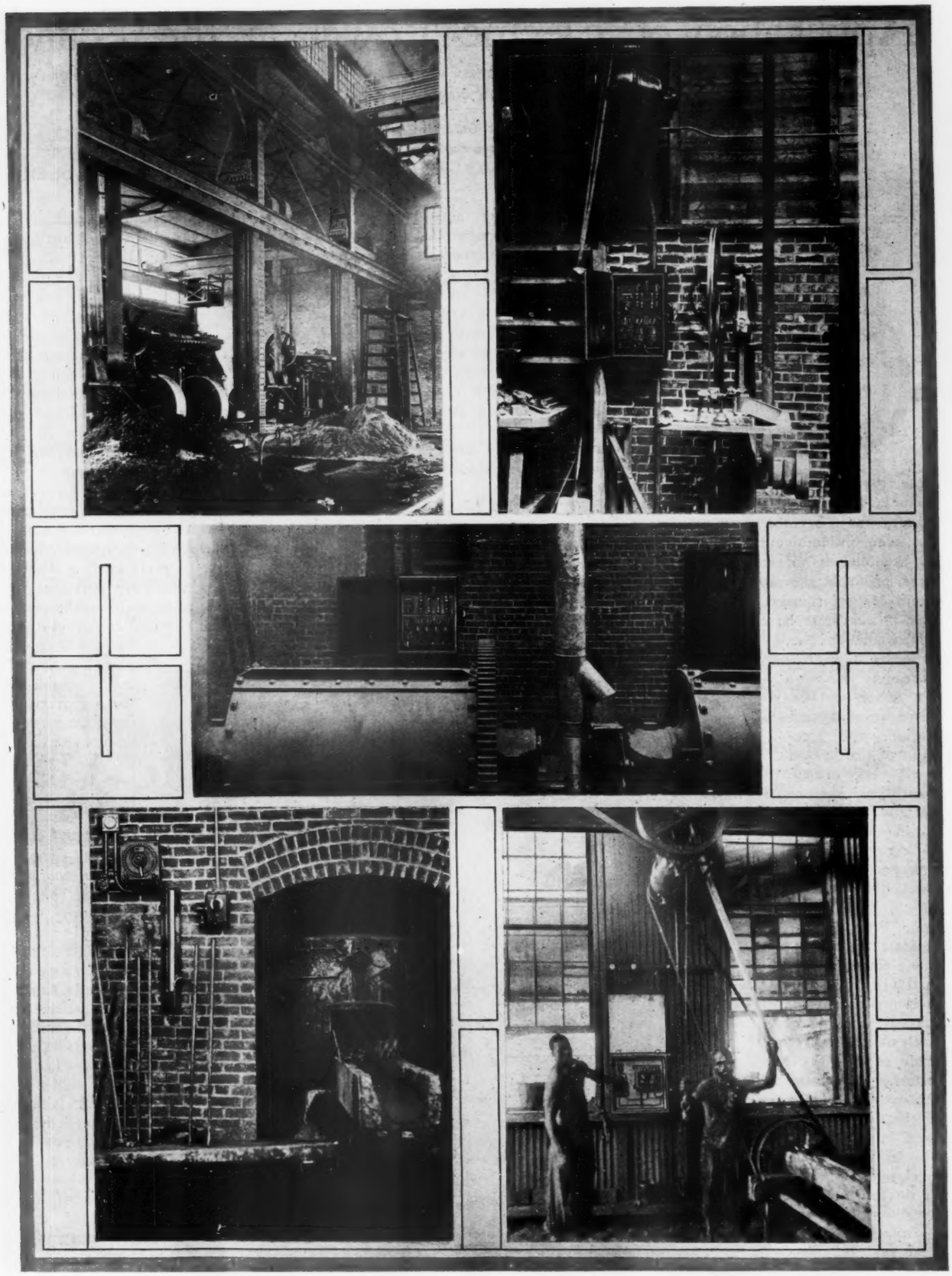


FIG. 2—SAND MILL MOTOR CONTROL

FIG. 3—AUTOMATIC STARTER FOR SPRUE CUTTER MOTOR

FIG. 4—MOTOR CONTROL FOR TUMBLING BARRELS

FIG. 5—PUSH BUTTON AND FIELD RHEOSTAT ON CUPOLA FOR CONTROLLING BLOWER MOTOR

FIG. 6—AUTOMATIC CONTROL OF MOTOR-DRIVEN, PIPE CORE MACHINE

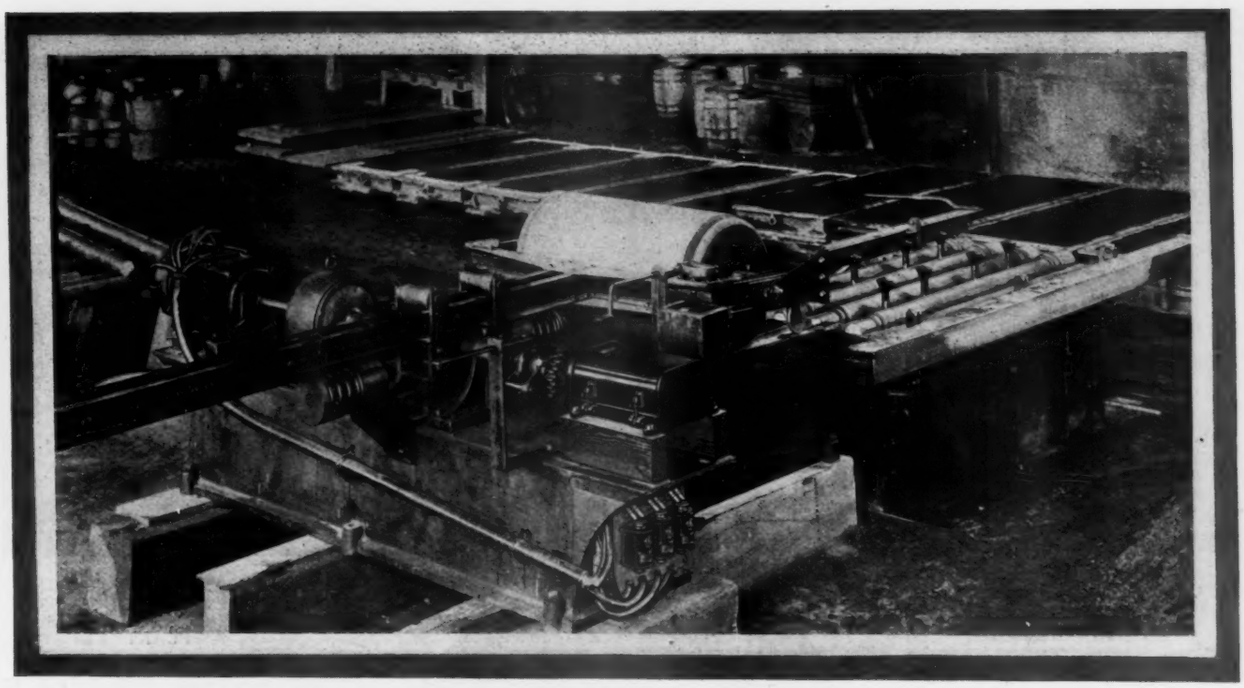


FIG. 7—OPERATOR'S SWITCH AND ACCELERATING UNIT FOR CONTROLLING OPERATIONS OF ROLLER-RAMMING MOLDING MACHINE

equipment will have on production and labor charges.

In the foundry, and in the allied metal trades, an electric motor merely supplying power, furnishes the least of the possible arguments for its use. It is not electric power that makes this subject so full of possibility and promise. It is rather *controlled* electric power. It is the ability to make the electric motor perform flexibly and automatically the various operations which are the bone and sinew of high speed production. It is the responsiveness and power of the controlled electric motor that enable a workman to do more work with less fatigue. It is the elimination of useless thought, worry and physical exertion that permits a workman to bend all his energy and ability to his real task, and as a quite natural result, to produce more work and better work; and it is the blending of these qualities of convenience, responsiveness, sense of adequate power and freedom from useless worry and work that is the real vital argument for the use of the electric motor.

Tons. per day.	Probable payroll No. of men.	per year ($2.75 per day.)	Tons per year.	Labor cost per ton.	Cost of electricity per ton.
5 to 10	40	$34,000	2,800	$12.15	$0.44
10 to 12	65	55,250	6,030	9.15	0.20
60 to 70	300	255,000	19,700	12.95	0.21
Average				$11.42	$0.28

The accompanying table was deduced from statistics published in the *Electrical Review* and *Western Electrician*, about a year ago, and relates to three different foundries, concerning each of which figures were tabulated for one year. Each of these foundries was pretty thoroughly equipped with the ordinary electric drive, and in each case the approximate number of men employed, and the approximate tons of metal cast per year, were known. It was assumed that the average wage of the men was $2.75 per day, and the cost of the electric power was 2 cents per kilowatt-hour. From these figures we secure the cost of labor per ton of metal cast, and the cost of power per ton of metal cast. This labor cost in the three different instances is $12.15, $9.15, and $12.95 per ton of castings. The cost of electric power, on the other hand, in the three cases, is 44 cents, 20 cents, and 21 cents per ton of castings. The average of these three cases gives a cost for electric power of 28 cents per ton of castings, and a cost for labor of $11.42 per ton of castings. In other words, if we take these figures as typical, in the motor-driven foundry, the cost of electric power is only 2½ per cent the cost of labor. The important deduction to be made is that any addition to the cost of electric power—even to the extent of doubling it—is relatively insignificant if, through its added convenience, only a small proportionate increase

FIG. 8—AUTOMATIC STARTER AND SPEED REGULATOR FOR GRINDERS

FIG. 10—MAGNET TRANSPORTING LARGE CASTING TO CLEANING FLOOR IMMEDIATELY AFTER SHAKING-OUT

FIG. 9—CASTINGS, GATES AND RISERS TRANSPORTED BY LIFTING MAGNET

FIG. 11—HANDLING HOT CASTINGS IN THE DUQUESNE STEEL FOUNDRY CO.'S PLANT

in production or decrease in labor cost is thereby secured. It is stated that during the last 50 or 60 years, the productive capacity of the industrial worker has increased in the ratio of 10 to 42, measured in dollars. During this interim the average laborer has certainly had his working hours shortened and the intensity of his effort diminished. What then can explain this enormous increase in productive capacity except the assistance which power-driven machinery has given to the workmen?

It is along just these lines of increased output and decreased cost, through the application of ingenious power-driven machinery, that the foundry industry has not grasped its full opportunity, and has not shown growth commensurate with that of very closely related businesses. These statements are, of course, general; there are instances where modern foundries have embraced a number of opportunities for installing the convenient modern devices which both accelerate and ameliorate the laborer's task. A recent installation furnishing a number of examples of this type is the plant of the Canadian Locomotive Co., Ltd., Kingston, Ont., this undertaking having been in charge of the firm of Henry Goldmark, consulting engineer, New York City. In this plant the various motors are started and stopped by automatic controllers, so that the workman merely pushes one button to start the motor and pushes another button to stop it. The motor or the driven machine cannot be injured, and the operations of starting and stopping are so basicly simple that they can be readily understood and executed by a very low grade of labor, or by foreigners not familiar with the English language and capable of not much instruction except by sign language. Fig. 5, for instance, is an illustration of the front of a cupola, and it will be noted that there is a push button and a field rheostat mounted for convenient operation by the man standing on the tapper's platform. The push button and the field rheostat are respectively for starting and stopping, and for regulating the speed of the motor which drives the blower for the cupola. This motor is an adjustable, direct current machine, the speed of which is regulated by field control. This is, in fact, somewhat of a departure from the more common method of regulating by insertion of armature resistance, but it is distinctly a step in the right direction for several reasons; first, on most cycles of operation it is more economical to install an adjustable speed, direct current motor with field control than it is to install a direct current motor with armature control, since in the last named case power is wasted all the time that the motor is running at speeds slower than the fastest; second, the operations of starting and stopping are distinct from the operation of speed regulation with the scheme here used, so that the selection of the right speed is not interfered with every time the motor is started and stopped; third, there is a stability of speed connected with the field control that is not present with armature control unless the load remains entirely constant. In this particular case it is evident that the man standing on the tapper's platform cannot only start and stop the fan,

FIG. 12—LIFTING MAGNET HANDLING STEEL FLASKS

FIG. 13—AFTER SHAKING OUT AND TOO HOT TO HANDLE, THIS CASTING WAS TRANSPORTED BY MAGNET

FIG. 14—LIFTING MAGNET LOADING CAR WITH GATES, RISERS AND SHOP SCRAP

but he can very definitely and easily regulate its speed and thereby regulate the speed of melting the iron.

Fig. 4, reproduced from a photograph made in the same plant, illustrates a portion of the cleaning room. A 20-horsepower motor drives two exhaust tumbling barrels and a fan dust exhauster. This motor is regulated by an automatic starter with remote control, so that for starting it is merely necessary to push one button, and for stopping to push another button. This operating unit, having its own motor drive, need not run idle and consume power during any period of time that the machinery is not in active use. It will be noted that this starter is enclosed in a sheet steel case to protect it from dust, which is a precaution and form of insurance well worth the trouble and cost in a foundry.

Fig. 3 shows the installation of an automatic starter for a motor driving a band saw sprue cutter in a brass foundry, this photograph also having been taken at the works of the Canadian Locomotive Co., Ltd.

Fig. 8 illustrates an automatic starter and a speed regulating field rheostat used in connection with a motor driving grinding wheels in the Duquesne Steel Foundry Co.'s plant, Coraopolis, Pa. In this case, starting and stopping of the motor are secured by merely closing and opening the knife switch, and the speed at which the machinery is driven is accurately and definitely determined by the setting of the field rheostat. Fig. 6 shows the application of automatic control to a motor-driven cast iron pipe coremaking machine in the American Cast Iron Pipe Co.'s plant, Birmingham, Ala. The remarkably developed negro in this view affords an illustration of a competitor for electric power that must be viewed with some concern. Speaking seriously, however, this picture really tells a story of how motor-driven machinery can be regulated safely and easily by the most ignorant labor where modern methods of automatic control are employed.

Fig. 2 shows an interesting use of motor drive and automatic starting and stopping applied to sand mills in the steel foundry of the Buckeye Steel Castings Co., Columbus. The only laborers permanently employed on these sand mills are used for shoveling sand, and certainly do not possess any knowledge of electrical machinery. An interesting installation has been made, mounting the automatic starters on the columns above the crane runway and locating the starting and stopping push buttons on the same columns near the floor. The shovelers at the sand mills find it easily within the range of their willingness and ability to start and stop these motors by merely pushing buttons, instead of possibly calling on an electrical man or foreman to perform these operations when needed.

Fig. 7 illustrates an application of motor drive and automatic control on a highly specialized machine which has been developed at the Snead & Co. Iron Works, Jersey City, N. J. This is a new type of the MacDonald roller-ramming molding machine for the manufacture of iron flasks used in soil pipe foundries, the operation of this machine having been described in detail in the July, 1913, issue of THE FOUNDRY. The interesting electrical features on this include what are called an operator's switch and an accelerating unit. By throwing the operator's switch by hand to one position, the motor starts, propelling the roller, and when the roller reaches its limit of travel, the operator's switch is automatically returned to the off position, converting the motor temporarily into a generator and stopping it quickly by dynamic braking. The motor then can be reversed by throwing the operator's switch to still another position, and after a certain length of travel the roller is

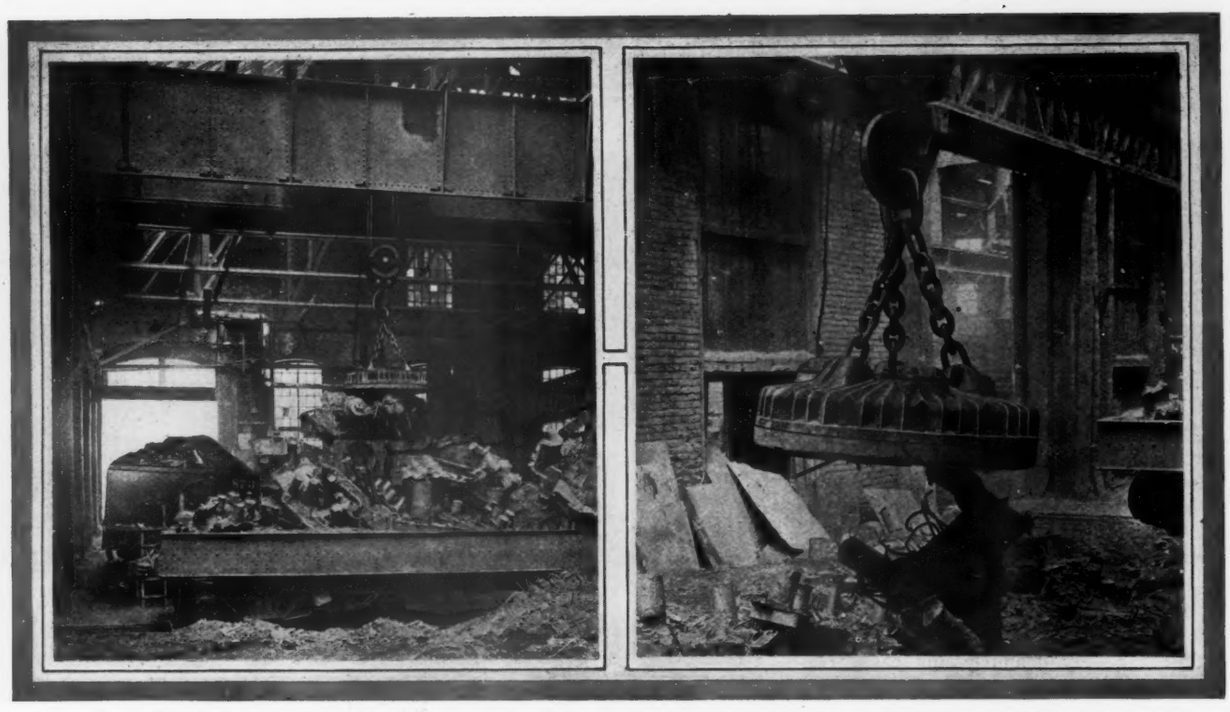


FIG. 15—LIFTING MAGNET LOADING CASTINGS TO BE CLEANED, ONTO FLAT CARS

FIG. 16—CLEANING-UP THE SHAKING-OUT FLOOR WITH A LIFTING MAGNET

again automatically stopped by dynamic braking at its initial position. All these operations are performed automatically without possibility of endangering the motor, and in absolutely the shortest safe amount of time.

In the technical papers and in manufacturers' bulletins, much has already been written about the use of the lifting magnet for unloading pig and scrap in foundry yards, and any one interested in this application of the magnet can easily secure definite information as to cost of installation, lifting capacities and economies effected, which are not merely theoretical, but which are backed by sufficient experience in numerous installations to convince the most skeptical.

Internal Use of Lifting Magnets

There is, however, another use of the lifting magnet in foundry work which has had little, if any, public discussion, and which is thoroughly in line with the policies and methods argued for in this paper. The application referred to is what might be termed the internal use of the magnet in the foundry. It is the use of a lifting magnet for handling flasks, copes and castings, picking up castings, grates and risers from the sand, and cleaning the sand of nails and other small pieces of iron or steel.

In a good many of the large, modern foundries, lifting magnets are used for an astonishing number of interior operations, and in such a capacity their effect is very important and contributes directly to the two results which have been previously mentioned as probably being the most profitable lines of endeavor along which the foundry manager can exercise his ingenuity. These two points briefly are, increasing production and decreasing labor charge without proportionally increasing equipment.

In a certain foundry where a magnet is largely used in interior work,

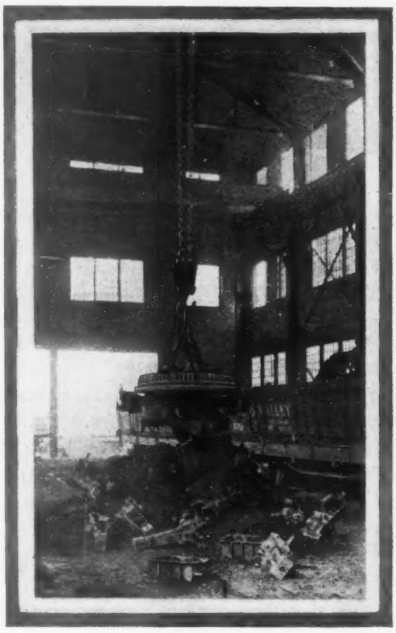


FIG. 17—STEEL COUPLERS REMOVED FROM SHAKING-OUT FLOOR BY LIFTING MAGNET

a description of its various operations will probably be of considerable interest. After the castings have been poured they are shaken-out by two men who first lift off the cast steel cope flasks. These are then stacked on edge, side by side, between the rows of molds. The crane then comes along with a magnet, picks up these cope flasks, generally getting four or five to a lift and sometimes more, and stacks them in a pile at one side of the molding floor.

The castings, which in this particular foundry, are not very large, are then dragged from the sand by means of a hook and are tipped into piles which include several castings. These piles are picked up with the magnet, carried to the end of the building and dumped at a point where the castings are rough-cleaned and the risers broken off. The drag flasks then are picked up by the magnet and handled the same way as the cope flasks.

Cleaning the Sand

For the next operation, the magnet is lowered to within a few inches of the sand and is slowly moved along horizontally, gathering up all the small pieces of iron which have been left in the sand. This use of the magnet is so effective in its cleaning that the sand is seldom screened to remove the iron, nails, etc.

The number of laborers required for cleaning up the floor has been conspicuously reduced, only about three men being required to clean up

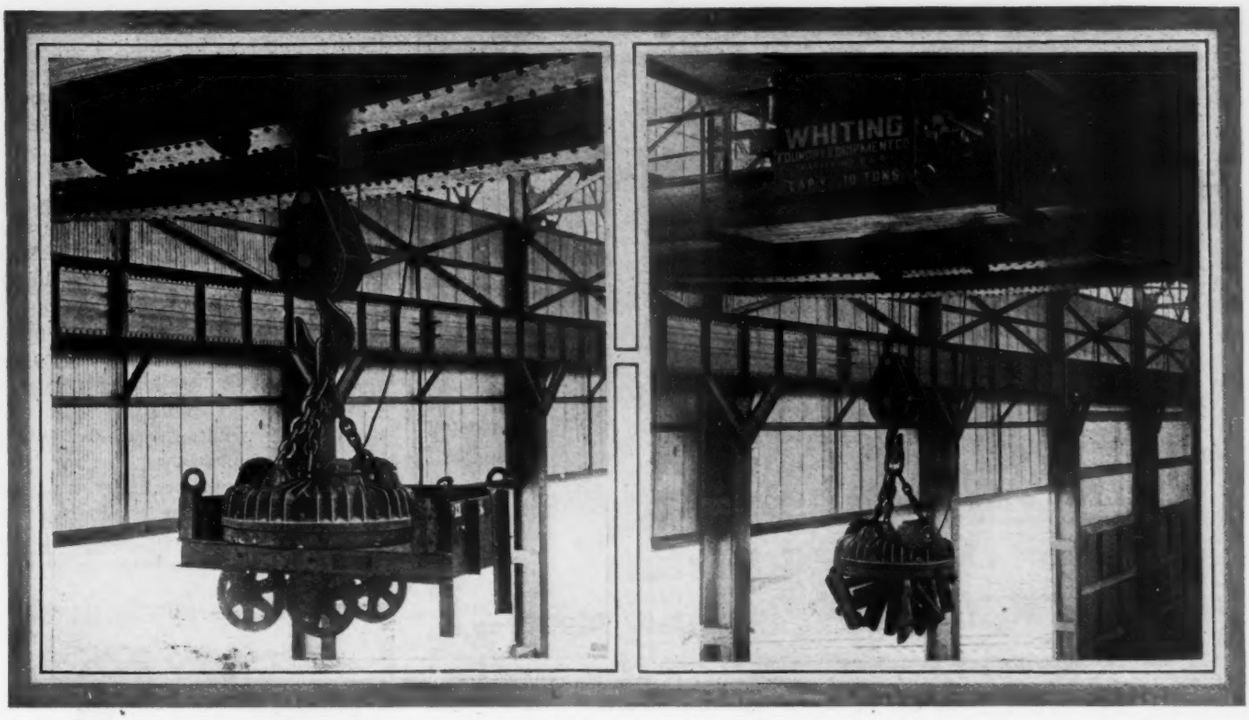


FIG. 18—LIFTING MAGNET TRANSPORTING CHARGING CAR

FIG. 19—LIFTING MAGNET CARRYING PIG IRON

the entire floor of this rather large foundry.

This magnet also is used for handling such equipment as steel boxes or buckets which are used for conveying sand from one point to another, as the crane operator can make better time handling these with the magnet than he could if he had to wait for a man to fasten the crane hook on the article to be moved.

Another interesting use of the magnet in this particular foundry is for filling the charging boxes for the open-hearth steel furnaces.

Economies Effected

The combined economies of the operations that have been cited are large. The number of laborers has been reduced and the speed of producing castings has been materially increased because instead of waiting for the castings to cool off they are handled while they are hot.

Fig. 12 shows a lifting magnet conveying cope and drag flasks from the molding floor after the molds have been dumped.

Fig. 18 illustrates the method in which the magnet is used for picking up and transporting charging cars at the plant of the Canadian Locomotive Co., Ltd.

Figs. 17 and 20 show an interesting phase of the work at the plant of the Buckeye Steel Casting Co., Columbus. Here the flasks are dumped, leaving the sand and the castings in a confused pile. While the castings are still much too hot to handle by hand, they are picked up with a magnet from the pile of sand and promptly conveyed to the cleaning room.

Figs. 10, 11, 13 and 16 illustrate different lifting magnets handling castings in the interiors of foundries. Fig. 11 shows the lifting magnet at work in the plant of the Duquesne Steel Foundry Co., and the other three were secured at the foundry of the Bethlehem Steel Co., South Bethlehem, Pa. In all of these cases the castings are picked up without waiting for them to cool much below a dull red heat, and it is of course obvious that by this procedure the production is materially speeded up.

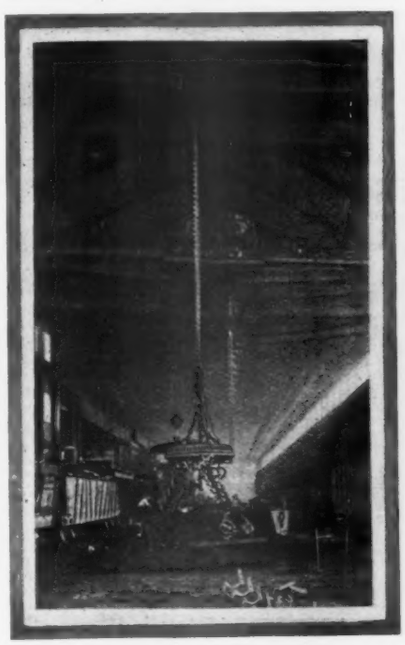


FIG. 20—LIFTING MAGNET TRANSPORTING HOT CASTINGS TO THE CLEANING ROOM

Fig. 15 illustrates a lifting magnet loading large castings onto a flat car preparatory to shipment to another department where they will be cleaned.

Figs. 9 and 14 show lifting magnets handling and loading gates, risers, etc.

Fig. 19 is an illustration of a lifting magnet handling a good load of pig iron. Of course, any foundry that possesses a lifting magnet should utilize it for the unloading of pig and scrap.

Electric Traveling Crane

There remains the electric traveling crane to discuss as an important illustration of power-driven machinery in the foundry. Rather conspicuous changes in the electrical equipment of modern cranes have occurred within the last two or three years. This statement applies more particularly to the cranes used in steel mills where the conditions are most exacting as to the severity of service and importance of uninterrupted operation. As a natural result, the most advanced crane practice finds application in steel mills, and we are justified in examining these new develop-

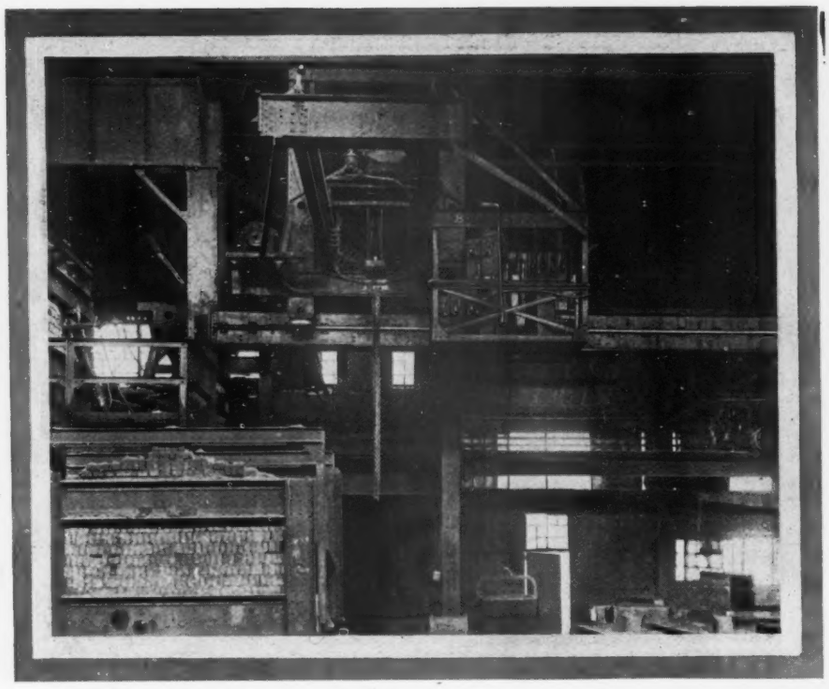


FIG. 21—TRAVELING WALL CRANE WITH MAGNETIC SWITCH CONTROLLER

ments as indicating the general trend of progress in crane design.

Some of these features of recent development have crept into the design of foundry cranes to only a small extent as yet, but as the reasons for their use in the foundry are basicly correct, it can be expected that the near future will witness their more prevalent adoption.

The three features of the electrical equipment of modern mill cranes, which have been the subject of the most important recent development, are: First, the use of the dynamic braking hoist controller without a mechanical brake in place of the old reversing controller with a mechanical brake; second, the use of magnetic switch controllers for motors on cranes which are worked very rapidly or on which the motors are of relatively large horsepower; and third, the installation of safety devices.

In regard to the first, without going into this matter in detail, it merely may be stated that a dynamic braking hoist controller elevates the load in the usual manner, but lowers the load by temporarily converting the motor into a generator and securing the required lowering speeds by making various electrical changes in the dynamic braking connections. The great argument for the use of dynamic braking controllers in the steel mills has been the fact that it eliminated entirely the use of the mechanical lowering brake, which, in such service, has proven to be unreliable and subject to heavy depreciation charges. In the steel foundry, where work is hard and rapid, the mechanical brake has been a source of prolific trouble, and, quite naturally, we find at present numerous installations of dynamic braking hoist controllers on cranes in various steel foundries. In the iron foundry, where, as a rule, conditions are not so exacting, the mechanical brake has not been the constant source of annoyance and expense that it has in the steel mill and the steel foundry. There is, however, another

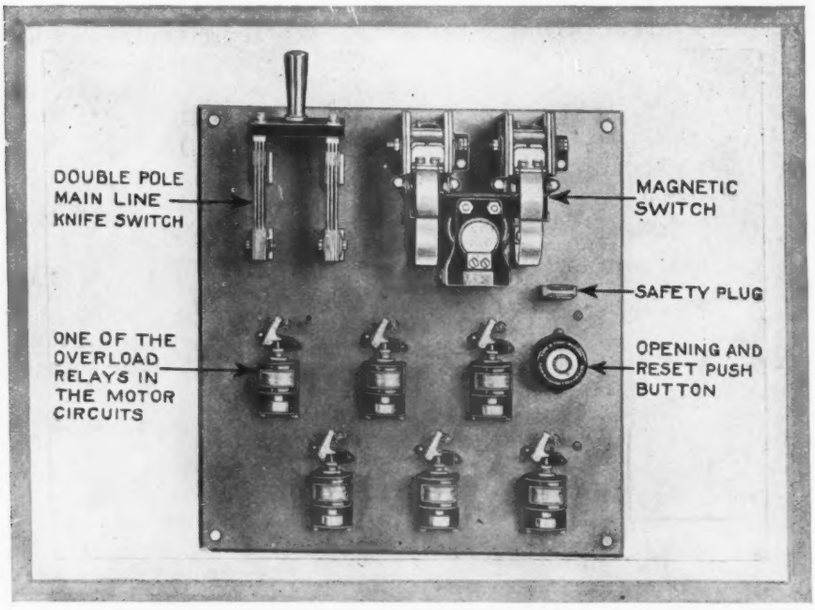

DOUBLE POLE MAIN LINE KNIFE SWITCH
MAGNETIC SWITCH
SAFETY PLUG
ONE OF THE OVERLOAD RELAYS IN THE MOTOR CIRCUITS
OPENING AND RESET PUSH BUTTON

FIG. 22—CRANE SWITCHBOARD, WITH EXPLANATIONS OF VARIOUS PARTS

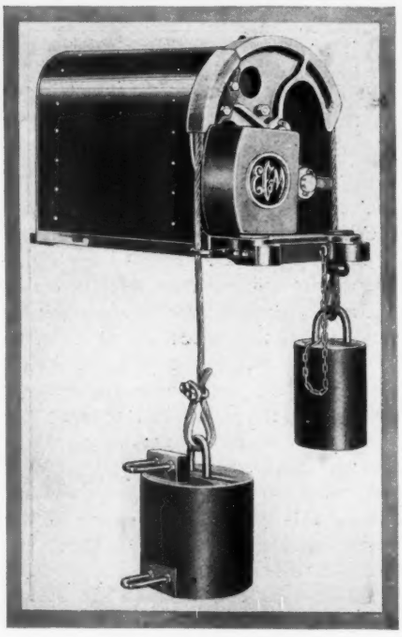


FIG. 23—SAFETY LIMIT STOP

important feature of operation of the dynamic braking hoist controller, which makes it of decided interest not only to the steel foundry but also to the iron foundry. This feature is the excellent and stable speed regulation which is obtainable. By adding a shunted armature connection on the hoisting side and employing regular dynamic braking connections on the lowering side of the controller, extremely slow speeds can be obtained on the first points, hoisting and lowering. Not only are these speeds slow after they have been reached, but there is no appreciable shock or jar when the controller is moved to the first point, either hoisting or lowering, nor is there the necessity for moving the controller to the third

or fourth positions to start and then bringing it back to the first point in order to slow it down after the motor shall have once started.

Both of these slow speed connections give to the series motor somewhat the characteristics of the shunt motor; that is, they tend to run it—and if necessary to develop high torque—without gain in speed as the load is diminished. This is in distinct contrast to the series motor, controlled merely by the insertion of resistance in series with the armature. The value of these speeds which are not only slow but stable, is, of course, apparent in connection with many operations in foundry practice.

The experience of the last few years has clearly illustrated the wisdom of applying magnetic switch controllers to motors on cranes which are subjected to severe service, or on cranes carrying large motors. When magnetic switch controllers are used, the crane man merely operates a small master controller. The main motor currents are automatically controlled by magnetic switches, and no matter how fast or senselessly the craneman moves the master controller, the motor cannot be abused, due to the automatic action of the magnetic switches. At the same time, these magnetic switches automatically perform the operations of starting or reversing in the shortest, safe amount of time. In short, the installation of a magnetic switch controller speeds-up the operation of the crane decidedly, and it protects the motor and the driven machinery from abuse and resulting depreciation charges and delays.

Safety Devices

In response to the demands of the general movement for safety, there are found two important pieces of electrical apparatus which are now being widely installed on electrical traveling cranes. These are the crane switchboard and the safety limit stop.

The crane switchboard had its inception, several years ago, in the discussion and recommended design of the Association of Iron and Steel Electrical Engineers, and its wide adoption has been due largely to the safety features which it provides. It is made up generally of a circuit-breaker switch for disconnecting from the supply lines all the motors on the crane, overload relays for each motor circuit, push buttons for closing or quickly opening the circuit-breaker switch, and a safety plug, the removal of which makes it impossible to close the circuit-breaker switch, and thereby makes all the crane motors inoperative. In case of sudden danger, every motor on the crane can be stopped instantly by pushing the opening button, and by this action disconnecting the motors from their supply of power. As to the safety plug, this is intended to be removed and a lock placed in the front of its socket, by any man repairing or working on the crane, who thus insures that the crane shall not be moved until he has finished his work and has removed his lock and re-inserted the safety plug. The circuit-breaker switch, in connection with the overload relays, also provides overload production and stops the expensive practice of blowing fuses.

Safety Limit Stop

The safety limit stop is designed and used to prevent over-travel of the hook block in the hoisting direction. The more modern devices for accomplishing this purpose are generally operated directly by the hook block itself instead of being geared to the hoisting machinery, and they so operate that they forcibly stop the motor by dynamic braking instead of merely disconnecting the hoist motor from its source of power. Both of these features of operation are warranted by the results obtained, for they lead to absolute sureness of operation and extremely accurate stopping. On any crane the installation of a safety limit stop is worthy of consideration on the grounds of safety and increasing the safe working hoisting distance of the crane.

If there is any one concluding thought which the writer wishes to emphasize, it is his absolute conviction that, from observation of foundry practice as contrasted with, say, steel mill practice or machine shop practice, the foundry has the opportunity to secure material increase in speed of production and decrease in labor cost by the application of electrically-operated machinery.

Personal skill will always be required, but personal skill should be helped and not hampered by the means of manufacture. No outside manufacturers of machinery or electrical devices can solve this problem. Such manufacturers can merely furnish the different units which the foundryman must combine and apply with that degree of restless ingenuity which surely spells progress in any manufacturing art. All these things can be done and can be made to pay. The fact cannot be brushed aside, that in the foundries that are the largest, that are growing the most rapidly and that are making the most money, the use of power-driven, labor-saving machinery is most prevalent.

Keeping Foundry and Shop Lights Clean

In walking through a foundry and machine shop of the middle west, which was in most respects up-to-date, the writer recently remarked to the superintendent on the dirty, grimy condition of the numerous lamps and reflectors with which the shops were lighted, asking him why he didn't have them cleaned.

"Oh!" he replied, "it's cheaper to keep enough of them going all the time to give us ample light than it is to send men up there to clean them."

The writer asked him whether he had ever heard of a device known as a "cut-out hanger" which enables both the lamp and reflector to be lowered to floor from any height, quickly cleaned or renewed and hoisted into place again.

He said he had not and would be glad to have the name of the manufacturer, which was given to him.

For the benefit of any others similarly situated it may be said that the hanger consists of a suspension device in two parts, namely the upper fixture, shaped like an inverted cup, which can be attached to ceiling, bracket or span wire, and a disconnecting socket carrying the lamp and reflector. By means of this hanger, any lamp can be automatically cut-out of a multiple circuit, lowered or raised with a rope, and the connection to the circuit broken or restored by snap latches, catches and contact bars. The lights are naturally attended to in a fraction of the time necessary when ladders are used; and in shops where the crane has been depended upon by the trimmers, this expensive piece of equipment is saved for other work or from service overtime. Furthermore, all danger from electric shocks is eliminated. The greatest advantages, however, are derived from the saving of current, and the clear, uniform illumination made possible by good lights, which usually has a decided influence on the quality of the work. This hanger is manufactured by the Thompson Electric Co., Cleveland.

Charcoal should never be used as a covering for aluminum, as this metal is so light that the charcoal is liable to become intermingled with it and the castings will contain small particles of this material.

THE BRASS FOUNDRY

Recent Improvements in Non-Ferrous Alloys

By C Vickers

TO OUTLINE the improvements that have been made in the metallurgy of iron and steel during the last half century would be a comparatively easy task, as they have been both numerous and epoch-making, having revolutionized this important industry to such an extent that present methods of manufacture bear little resemblance to the practice of earlier days.

Many metals that once were rare have become commercially available and are extensively used for deoxidizing and purifying iron and steel products. Only a few years ago manganese, silicon, titanium, vanadium, tungsten, chromium and molybdenum were practically unknown, whereas today they are almost as familiar to the metallurgist as iron and steel, and are used in the latter with a full understanding of the effects they will produce.

Progress in Non-Ferrous Metals

In the non-ferrous industry, however, it is more difficult to outline the improvements that have been made in recent years, as there have been no revolutionary discoveries in connection with copper or its alloys. Some new alloys have been formed, it is true, but these consist primarily of improvements effected on old alloys by the use in the form of deoxidizers, of the more recently discovered elements than of entirely new alloys.

This lack of progress in the non-ferrous field is not due so much to neglect on the part of investigators, for in recent years the non-ferrous metals and alloys have been carefully and comprehensively studied, but is rather an indication of the difficulty of effecting such improvements. In the natural order of things, the metals first utilized by mankind were those easily won from their oxides or other combinations, or found in their metallic state.

Copper First Used

For this reason copper was the first metal used in the arts, tin being the first metal alloyed therewith, and throughout many centuries the combination of copper with tin never has been improved upon. The ancient bronzes differed little from those of modern times, in fact, the same formulas are used today as were used ages ago. The old bronzes, prior to the Roman era, were composed of copper and tin almost entirely, and to the Romans is credited the introduction of lead into these alloys.

Old sword blades contained from 8 to 10 per cent and coins from 7 to 15 per cent of tin, with an occasional small percentage of iron. The Roman coins frequently contained lead in addition to the tin, and it is worthy of note that the modern bearing alloy containing 20 per cent of lead, 7 per cent of tin and the balance copper, was used by the Romans for coinage 500 years before Christ.

The lapse of centuries has witnessed little change in the composition of alloys, and the reason for this is attributed to the fact that tin is by far the most satisfactory metal that can be used to alloy with copper. This makes difficult the work of improving non-ferrous alloys, for among all of the new metals that have been discovered, none in any way resembles tin in its effect upon copper. Tin, of course, has its limitations. Tin alloys are not as strong as those of copper and zinc, but it forms a superior casting metal, and this advantage more than compensates for lack of strength, as the latter can be gained by increase of section.

Many of the recently commercialized elements used in connection with iron and steel, either cannot be used in non-ferrous metallurgy, or are of value only in the form of deoxidizers. This applies to all of the metals referred to at the beginning of this article. Manganese and silicon are the most extensively employed, but manganese only finds application as an alloying metal with copper, and this only to a limited extent. Silicon is used almost exclusively as a deoxidizer for copper, when the electrical conductivity of the castings is not of particular importance. Silicon possesses the advantage of cheapness, and for that reason is used largely in making such copper castings as blast furnace tuyeres, etc. For use in copper founding, silicon is employed in the form of a rich alloy of silicon and copper, from 1 to 2 per cent of which is added to molten copper to produce sound castings.

This rich alloy of silicon and copper usually contains 10 per cent of silicon, a small amount of iron and the balance copper. At the present time it is made by melting together copper and ferro-silicon, the latter containing over 90 per cent silicon. The alloy is easily made in a brass melting furnace having a good draft. The copper and the silicon can be charged together, or the copper can be melted first and the silicon added in granulated form; regardless of the method adopted, if 4 pounds of 95 per cent ferro-silicon are added to 25 pounds of copper, the analysis will show approximately 7.71 per cent of silicon in the copper. This alloy will be brittle, but will produce sound copper castings when used in the proportion of 1 per cent.

Silicon in Brass and Bronze

Silicon has no value as a deoxidizer of brass and bronze, particularly if the latter contains lead, when dirty castings will be produced. This is due to the formation of lead silicate, extruded from the metal in the form of a white powder, making deep pits in the castings as it solidifies in the mold. When no lead is present in copper-tin alloys, silicon can be used, but its effect is greatly inferior to that of phosphorus; therefore, no ad-

vantage is to be gained by its use. In copper-zinc alloys, in which no lead is present, silicon often can be used to advantage in small castings, as it imparts fluidity to the metal the same as aluminum. However, silicon should be used in preference to aluminum, as the former will run cleaner castings than the latter. While silicon will form dross in copper and its alloys, less of it will be formed than if aluminum is employed and the chances of obtaining clean castings are much greater. For this reason silicon frequently is used in yellow brass in place of aluminum, where the absence of lead will permit of its addition.

Silicon also can be substituted for aluminum in manganese bronze to impart fluidity to the alloy, and it occasionally is used with aluminum to increase the elongation of an alloy. In yellow brass, however, silicon should not be used for castings subjected to vibration, as it is liable to cause crystallization. In conjunction with iron, silicon alloys with copper, forming an excellent bronze. It should be introduced in the form of ferro-silicon, preferably the 20 per cent alloy. The copper first is melted to a high temperature under charcoal and then the ferro-silicon is added in powdered form, with a flux of sodium nitrate. An alloy of copper and 6 per cent of 20 per cent ferro-silicon, developed a tensile strength of 49,000 pounds per square inch, an elastic limit of 24,190 pounds per square inch and an elongation of 50 per cent in 2 inches.

Substitute for Tin

There is some possibility, therefore, that alloys of ferro-silicon and copper may find application in the future as substitutes for copper-tin alloys when the price of tin still further advances. A substitute for tin is being anxiously sought, as it is a rapidly disappearing metal, and due to the constantly growing demand, its price is steadily seeking new high levels. Therefore, unless new and large deposits of ore are discovered, the problem of the future supply of tin will become serious.

There is, of course, the remote possibility that the transmutation of metals will become an accomplished fact in the future. The old alchemists believed it was possible to change one metal into another, and they labored hard to change lead into gold, without due appreciation of the insurmountable difficulties the operation involved. Their knowledge of chemistry was superficial as compared to that of latter-day chemists who have delved more deeply into the science of how things are created and who are convinced of the stability of the elements. The discovery and subsequent study of radium, however, upset many firmly established and scientific theories, and since the element, hydrogen, has been converted into two gases, neon and helium, other similar changes are considered among the possibilities, even the transmutation of one metal into another.

Lead Transmuted Into Tin

The transmutation of lead into tin, however, at present seems to be remote, and the non-ferrous metallurgist, confronted with the increasing value of tin, will not place much dependence on the possibility of being supplied with this metal from such a source, but will seek means to use tin as economically as possible in making alloys. In this connection it should be stated that more can be accomplished to advance tin economy in alloying by the judicious use of deoxidizers, as such, than by the use of such questionable substitutes as antimony, which, in spite of its hardening properties, far surpasses lead in its strength-destroying effects on copper alloys.

Silicon is the best carrier of iron into copper alloys of any of the latterly utilized elements. It is claimed that manganese is used in manganese bronze as a carrier of iron. This statement is not borne out by the facts. Manganese does not carry iron, that is, it does not cause iron to combine chemically with the copper, nor does it cause it to be held in suspension in the copper in any other form than iron is usually found, in the form of nodules; therefore, manganese is a failure as a carrier of iron. Silicon, however, causes iron to chemically combine with copper; the 6 per cent ferro-silicon alloy, previously mentioned, is a true silicon bronze. In color it resembles a 10 per cent tin alloy, and it machines with the same ease. As no nodules are present in the alloy, it follows that the iron is chemically combined with the copper, forming an iron-silicon-copper alloy. It is essential, however, to add the iron to the copper in the form of ferro-silicon; if the iron is added separately, for example, in the form of tin plate, and the silicon as ordinary silicon-copper, a different result will be obtained; the color of the copper will not be changed materially, and the iron will be distributed throughout the copper in the metallic form. The iron, however, will not be present in the form of nodules, nor will it offer more that the ordinary resistance to the tools in machining. If the polished surface of the alloy is moistened, the particles of iron it contains will rust, indicating that the latter metal is distributed throughout the copper in its metallic form.

The iron carried by ferro-manganese into copper is in the form of nodules. The latter are exceedingly hard, being practically manganese steel, and they must be ground, as it is impossible to file them. When the alloy is polished it rivals German silver in appearance, but only for a short time. The exposed nodules of iron soon rust, and if the alloy is exposed to dampness or is used around water, rusty streaks will spread from each particle of iron, and finally the entire surface of the alloy acquires a dirty, yellowish color. This is one reason why manganese-copper alloys are not used in place of German silver to any great extent. The only method by which these alloys can be made economically is objectionable for the reasons stated.

Manganese-Copper Alloys

Alloys of ferro-manganese and copper are easily made in any good brass melting furnace. An alloy containing 15 per cent manganese is white and exceedingly strong, and alloys well with lead and zinc. An alloy of 64 per cent (16 per cent) manganese-copper, 32.75 per cent zinc and 0.25 per cent aluminum, is white, strong and stiff, and has a dense, pearl gray fracture. Another alloy consisting of 72 per cent of 16 per cent manganese-copper, lead 27.75 per cent and aluminum 0.25 per cent, forms a fine white alloy with a pink tinge when cut. The undesirable feature of these alloys is that they contain nodules of iron, which are so hard that they cannot be machined. If some reasonably cheap method could be devised for making an iron-free manganese-copper containing approximately 15 per cent manganese, numerous alloys of copper and manganese could be utilized commercially, and as they can carry large percentages of lead, they would prove particularly useful for bearings. The two elements, silicon and manganese, therefore, afford some hope of replacing alloys of tin, should a famine in that metal really occur. At present, however, these elements are used chiefly as deoxidizers in non-ferrous alloys. Manganese in the brass trade occurs as manganese-copper containing from 25 to 30 per cent of manganese. Manganese-copper usually is made by the addition of ferro-

manganese to copper, and consequently contains iron. The analysis of a German brand of manganese-copper, extensively advertised in this country, showed manganese, 28.64 per cent; iron, 2.53 per cent, and copper, 68.83 per cent.

Manganese Bronze

Manganese usually is added to the bronze of that name, in the form of manganese-copper, but it also can be used with equally good results, in the form of 80 per cent ferro-manganese, provided the ferro-alloy is added in a granulated form to a portion of the copper and precautions are taken to insure that it is dissolved before the balance of the copper is charged. Manganese bronze is essentially a copper-zinc alloy, the physical qualities of which are improved greatly by the addition of small quantities of manganese and aluminum. It is, therefore, an old alloy with modern improvements. Copper-zinc-iron alloys were known and used for years before the advent of manganese bronze, and the latter metal is simply a ferro brass, to which has been added manganese and aluminum. The latter metal confers fluidity upon the alloy and is essential, not only for the casting qualities which it confers upon the metal, but because it also imparts strength to the alloy.

A number of different formulas are followed in making manganese bronze; some contain a small amount of manganese, others, a comparatively large percentage; several mixtures contain considerable iron, while others are made without this metal; a number of formulas specify a relatively large amount of aluminum and others only the minimum amount necessary to avoid casting difficulties.

When the percentage of zinc in an alloy is high, the aluminum must be low, otherwise the alloy will be brittle as aluminum possesses three and one-half times the hardening power of zinc. When the maximum amount of the latter is used the addition of only 1 per cent of aluminum will make the alloy exceedingly brittle and practically worthless. In the case of manganese bronze, it is but a step from strength to weakness, and for this reason great care is required in weighing the proportions of the various metals that comprise the alloy.

A low manganese alloy should carry tin, otherwise the elastic limit will be low. While it is contended by some that the elastic limit is of little importance, nevertheless it is a fact that a tinless manganese bronze is improved by high manganese. There is a wide difference between the formulas of the two alloys given below, but their physical properties do not vary greatly. One contains low manganese and low aluminum, and the other high manganese and high aluminum, with the addition of tin to the first alloy, which consists of copper, 56 pounds; zinc, 42 pounds; iron, 1.50 pounds; tin, 1 pound; aluminum, 0.50 pound, and 80 per cent ferro-manganese, 0.50 pound. This alloy was cast into ingots and 25 pounds were remelted with the addition of 1 per cent of 10 per cent titanium-copper. The average physical test results of three bars were as follows:

Tensile strength, pounds per square inch	85,300
Elastic limit, pounds per square inch	48,800
Elongation in 2 inches, per cent	21.3
Reduction of area, per cent	22.1

The second alloy was made as follows: Copper, 52 pounds; zinc, 42 pounds; 80 per cent ferro-manganese, 6.25 pounds; aluminum, 1 pound; aluminum-titanium (4.53 per cent Ti.), 1 pound. This alloy possessed the following physical properties:

Tensile strength, pounds per square inch	92,000
Elastic limit, pounds per square inch	43,200
Elongation in 2 inches, per cent	18.0
Reduction of area, per cent	17.3

A comparison of the two alloys will show that they are practically identical as regards physical properties, as the slight increase in the tensile strength of the second alloy is gained at the expense of ductility, which naturally would be expected. The two formulas serve as illustrations of the compositions of manganese bronzes, showing how widely they may differ without materially affecting the physical properties of the alloys.

Manganese in Yellow Brass

Manganese is an excellent deoxidizer of yellow brass; it should be used in homeopathic doses, and for convenience in making the addition, the manganese-copper can be diluted by adding 1 pound to 5 pounds of copper. Add 1 pound of this alloy to 100 pounds of brass, and increase or decrease this amount according to the results obtained. The end sought is a pleasing brown color on the castings; if the color is dark, it indicates the use of too much manganese and the percentage should be reduced. If there is no change in the appearance of the castings, not even an indication of a brown band under the head of the sprue, the manganese is insufficient and more of the diluted alloy should be added until the castings are a light, rich brown. The work then will cast better and will be free from porosity.

In copper-tin alloys, phosphorus is a better deoxidizer than manganese, but the two can be used in conjunction with excellent results. Manganese and tin is not a good combination, although manganese has been used in regular bronze, known as red manganese bronze; this alloy will not cast well without the addition of aluminum, and no longer is used to any extent.

Copper and Refractory Metals

The elements tungsten, chromium, cobalt and molybdenum are not used in copper alloys, because it is difficult to introduce them into copper on account of their high melting points. At the temperature of the electric furnace, the copper will volatilize before the more highly refractory metals are melted; in the case of molybdenum, when the ferro-alloy (85 per cent Mo) is used, no union with copper takes place, because the two cannot be melted together, owing to the fact that the copper cannot be heated to the melting point of the molybdenum. When molybdenum is melted first by the electric arc and the copper is charged, the latter instantly cools the molybdenum to the solid state, and it becomes diffused throughout the molybdenum in the form of pellets of undissolved metal. When the copper is remelted, these pellets rise to the surface as impurities and are skimmed off in their original form. The same is true of ferro-chrome, and possibly tungsten, while cobalt is similar to nickel. Copper will not unite directly with the refractory metals, unless the latter become plastic at the volitalization point of the copper. In this case the copper washes down the semi-liquid refractory metal and forms an alloy; otherwise, the only method for alloying these metals with copper is through the medium of aluminum, but the alloys will contain a sufficient amount of the latter element to affect them unfavorably.

None of the refractory metals can be mixed with copper to produce a serviceable alloy. With the exception of titanium, none of the refractory metals softens at the temperature at which copper volatilizes. Therefore, if the refractory metal melts immediately under the electric arc, the molten copper, with a lower temperature, immediately quenches the former to the solid state. Consequently, such alloys cannot be made by merely melting the metals together.

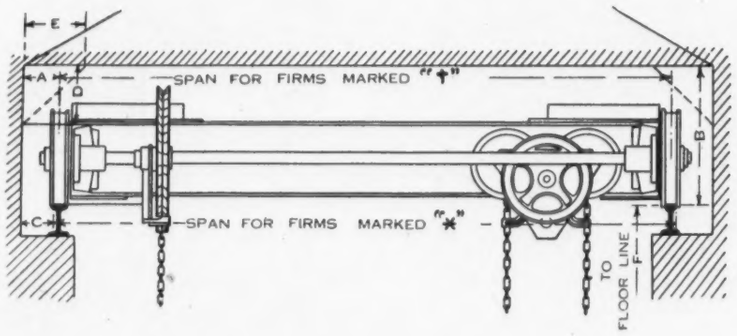
Boron is easily reduced from its oxide by aluminum. The oxide is known as boric or boracic acid, which contains considerable water, and first must be calcined to convert it into boric anhydride (B_2O_3).

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

CLEARANCES FOR HAND POWER CRANES

By W. L. Tryon



THE FOLLOWING CLEARANCES FOR A AND B OR C AND B IN INCHES, SHOULD BE ALLOWED IN NEW BUILDINGS.

Firms:— Tons		1	2	3	5	10	15	20	25	30	40	50
†Cleveland Crane & Engrg. Co.	A	..	..	..	5½	6	6	7	7	8	8	9
	B	..	..	..	48	54	63	69	72	78	84	90
*Curtis & Co. Mfg. Co. (1)	C	3⅛	3⅛	3⅛	3⅛	3⅛	..	..	..	..	..	..
	B	20	20	22	36	42	..	..	..	..	..	..
†Euclid Crane & Hoist Co.	A	..	7	7	8	9	9	10	..	..	..	..
	B	..	45	48	51	57	63	69	..	..	..	..
†Maris Brothers.... (2)	A	..	..	..	3¼	4½	4½	7	7½	..	..	..
	B	..	..	..	29 to 39	40 to 51	45 to 57	76	96	..	..	..
†Northern Engineering Works (2)	A	..	..	7½ to 9¼	8 to 9¼	8 to 9¼	9¾ to 10	9¾ to 10	9¾ to 10	10½	10½	..
†Northern Engineering Works (2)	B	..	..	31 to 34	34 to 45	41 to 48	43 to 48	45 to 51	45 to 57	63	69	..
†Toledo Bridge & Crane Co. (3)	A	..	..	..	5	6	7	7	8	8	9	9
	B	..	..	..	36	42	42	48	66	72	84	96
†Whiting Foundry Equipment Co.	A	..	..	..	6	7	7	7	7	7	8	8½
	B	..	..	..	51	54	57	58	62	76	76	79
*Vulcan Engineering Sales Co. (4)	C	4⅜	4⅜	4⅜	6½	..	..	..	..	..	..	..
	B	24	24	24	26½	..	..	..	..	..	..	..

Numbers in parenthesis, thus (1), refer to notes on Data Sheet No. 148.

(*Continued on Data Sheet No.* 148.)

CLEARANCES FOR HAND POWER CRANES

By W. L. Tryon

(*Continued from Data Sheet No.* 147.)

NOTES ON CLEARANCE TABLE.

(1) Clearances are for ordinary geared trolley, with a bar and link suspension, from which can be hung either air hoist or chain block.

Single I-beam crane for 1, 2 and 3 tons.

Double I-beam crane for 5 and 10 tons.

(2) Dimensions vary according to span.

(3) Dimensions are based on standard double beam girders and chain block trolleys from 5 to 20 tons, inclusive. Over 20 tons, on drum type trolleys.

(4) Based on single beam cranes.

INFORMATION REQUIRED IN ORDERING CRANES.

All manufacturers build cranes with dimensions smaller than those given in the table, when required.

When making inquiries about cranes, the following particulars should be given:

Load.—Maximum load in net tons to be lifted.
Speed.—If special speed for any function is required.
Style.—Type of crane preferred.
Span.—Span in feet.
A or C.—End clearance.
B.—Overhead clearance.
D and E.—Required if there are roof braces, which interfere with end travel of trolley.
F.—Distance from top of runway rail to floor.

Span is from center line to center line of rails for firm marked "*", otherwise it is from outside to outside of rails.

If equal parts of boric anhydride and fluorspar are melted together in a crucible, and molten aluminum is added, an alloy of boron and aluminum will be formed which can be made very hard and brittle, but thus far no use has been found for it. This alloy is too expensive to use in aluminum and even if it hardened the latter, boron would have no advantage over copper in this respect.

In aluminum bronze, boron-aluminum is of no value, although it has been claimed that its use will insure cleaner castings than otherwise can be obtained. For aluminum bronze, boron-aluminum is overshadowed by manganese chloride, used in the proportion of one-half of one per cent. The boron introduced with the aluminum has no hardening effect on copper. Although the boron-aluminum alloy, before its introduction to the copper, may be hard and glassy, the resulting aluminum bronze is apparently unchanged. It should not be inferred that the boron does not alloy with the copper, but rather that it has no marked hardening effect. Boron alloys or combines with iron to form ferro-boron, also with titanium to form ferro-titanium-boron; therefore, there is no valid reason for supposing that boron and copper will not alloy.

Boron Suboxide Flux

While boron probably never will be used in sufficient quantities to form alloys with copper, notwithstanding the patents that have been granted for alloying lead and copper by the aid of boron, this element, or rather a lower oxide, is extensively used as a deoxidizing agent for copper. This is known as boron suboxide flux. Sound copper castings also can be produced by fusing copper with 0.5 per cent of boric anhydride and a similar percentage of magnesium chloride.

Boron is closely related to carbon and similar to the latter it occurs in crystalline and amorphous forms. The latter form is prepared by reducing boric anhydride with sodium, and crystalline boron is produced by fusing amorphous boron with aluminum until the latter metal is saturated, when the boron segregates in crystals, which are obtained by dissolving out the aluminum. Neither of these varieties of boron is liable to play an important part in the metallurgy of non-ferrous metals.

Crystallized boron has properties similar to that of the diamond and has no value in metallurgy; the amorphous variety cannot be added to copper or its alloys directly, because it ignites and burns at 700 degrees Cent. Consequently, when adding it to copper, it is necessary to enclose it in a copper container and to plunge it to the bottom of the molten metal. If added directly, it either would burn on the surface of the molten copper, or it would be consumed before it reached that point. In any event, the boron would be wasted and the copper would produce porous castings.

Magnesium

Magnesium is another element introduced to non-ferrous metallurgists in recent years. It is a powerful deoxidizer and theoretically should be of great value in that respect as an addition to copper and its alloys. Experience has shown, however, that it does not necessarily follow that because a given element has a great affinity for oxygen, that it is of value in copper or its alloys. In fact, the element may and often actually does, increase the tendency of the metal or alloy to retain gases in suspension. This is the case, to a limited extent, when magnesium is added to copper, but some alloys are thus affected to a marked degree. Copper deoxidized with magnesium frequently produces castings apparently sound and clean, but when machined, they reveal a mass of blow-holes underneath the skin. Frequently, also, when magnesium-deoxidized castings are machined, deposits of magnesia are found in the form of white particles and cloudy patches, which may extend a considerable distance into the body of the casting. This is an unfortunate property of magnesium, as otherwise this element would be an excellent deoxidizing agent for copper, the resulting castings possessing high electrical conductivity.

It is comparatively easy to alloy magnesium with copper, in spite of its great affinity for oxygen; all that is necessary is to cover the surface of the molten copper with some refractory oxide, such as powdered dolomite, magnesia, or lime, and to plunge the magnesium under the surface of the copper and to hold it there until it dissolves. This can be accomplished conveniently with a pair of long tongs, the sticks of magnesium being cut to a length that will permit them to be plunged horizontally into the crucible.

A 10 per cent magnesium-copper alloy is easily made and very little magnesium is lost in the operation. This alloy is brittle and usually is full of tubular holes, radiating from the bottom and sides of the ingot; such an alloy forms an excellent means of adding magnesium to copper when it is desired to use it in the form of a deoxidizer.

In brass and bronze castings, magnesium must be used in exceedingly small doses, otherwise it will do more harm than good. For such additions the 10 per cent magnesium-copper is better than the metal itself, as the requisite amount can be more accurately added. The property of increasing the solubility of gases in alloys when combined with other elements of the same group, is possessed by magnesium to a marked degree. Thus, it is possible to make any alloy porous by the addition of small amounts of these deoxidizers. A 10 per cent aluminum bronze can be converted into a spongy mass by the addition of an astonishingly small amount of magnesium so combined.

Other metals that might be included among the *newer* elements that have become commercially available, are sodium and calcium. Sodium, however, cannot be directly alloyed with copper, but burns on the surface of the molten metal without entering into solution in any way. Therefore, it cannot be used as a deoxidizer of copper by direct addition, and it would be dangerous to plunge the sodium underneath the surface of the molten copper, as it would cause an explosion. While the metallurgy of sodium is interesting, it will not be considered, as it has no application in non-ferrous alloys.

Calcium

Calcium alloys with copper in all proportions; an alloy of 12.5 per cent calcium is brittle, but pleasing in appearance. Metallic calcium is unpleasant to handle, and in appearance it is unlike any other metal. Calcium is sold in the form of sticks, 18 inches long, 2 inches in diameter and circular in form. These sticks are very irregular, being built-up of circular accretions of metal. When exposed to the air, calcium combines with the moisture in the atmosphere and becomes covered with a slimy deposit of oxide, which is constantly dropping off and forms a semi-liquid mass. Calcium should be kept in cans with a tight-fitting cover, which should be placed in a dry, warm place. In this respect calcium differs from sodium, as the latter is best preserved in some hydrocarbon liquid, such as gasoline or naphtha; calcium, on the other hand, decomposes these liquids. Calcium is valueless as a deoxidizer of copper. When used for this purpose, and if any calcium remains in the copper, it will cause the absorption of gases, thereby producing minute holes in the casting. If it were possible to accurately gage the amount of oxide in the molten copper, and then to add just the proper amount of calcium to remove the oxide and leave no residue, calcium would give excellent results, as castings so deoxidized possess an

electric conductivity of from 93 to 96 per cent.

Another element that only recently became available for use in non-ferrous metals is titanium. It is difficult to separate from its combinations with oxygen, and for that reason is one of the most energetic deoxidizers known. In the metallic state it alloys perfectly with copper in all proportions; an alloy of 8 per cent titanium in copper resembles tool steel in hardness and the manner in which it fractures.

Such an alloy develops considerable tensile strength, but very little elongation. The fracture of the metal shows a close, homogeneous grain, of a reddish color inclined to lilac, and the freshly-broken surfaces soon oxidize to a darker hue. This alloy is an energetic deoxidizer of copper, brass and bronze. In copper, 0.5 per cent of the 8 per cent titanium alloy has produced sound castings, with an electrical conductivity ranging from 96 to 99 per cent. In brass and bronze it is equally efficient. The alloy is made by melting the copper and adding the titanium in the metallic form. This operation requires considerable skill.

Metallic titanium is obtained as an amorphous powder and in massive form, and the two varieties are mixed and are added to the copper. The difficulty of the operation consists in introducing the metal into the copper without burning away the titanium. The powdered variety can be ignited with a match and will burn away completely to oxide, with the evolution of intense heat and a reddish-colored flame; titanium is so easily ignited that when combined with substances that easily give up oxygen, it forms a powerful explosive. Under these conditions, therefore, alloys of copper and titanium cannot be prepared by the uninitiated. The melting point of titanium is about 3,450 degrees Fahr., and that of copper, nearly 2,000 degrees Fahr., yet the alloy of titanium and copper dissolves without difficulty in molten copper, bronze or brass. Pure titanium bronzes combine toughness with strength to a remarkable degree, and there is little doubt but that when the process of manufacture is satisfactorily developed, these metals will find extensive use as materials of construction.

Some idea of the power of titanium as a deoxidizer can be gained from the fact that one pound of metallic titanium will thoroughly deoxidize 1,600 pounds of copper, even if the latter, before melting, was in the form of oxidized scrap; in the case of clean metal, one pound of titanium will remove the oxygen from a ton of molten copper, and will insure the production of clean, sound castings.

When properly treated, aluminum produces sound, clean castings, but great care must be exercised in melting, to avoid overheating the metal, as it possesses a great affinity for oxygen. When the metal is heated to a certain temperature it will combine with the excess oxygen in the furnace, resulting in the formation of large masses of pasty dross, causing expensive waste. In addition to the formation of dross, overheated aluminum absorbs oxygen, and some nitrogen, these gases creating minute holes, which are distributed throughout the structure of the metal. When the casting is polished, these holes are revealed as minute black spots, which are filled with dirt.

To avoid this difficulty, the aluminum, when charged into the crucible, should never protrude above the top of the pot. The ingot either should be cut to convenient size, or a crucible ring should be employed to increase the depth of the crucible. When fine scrap has to be melted, a molten bath of ingot metal should be formed in the crucible; this should be heated to redness and the scrap dissolved therein. A pyrometer will prove of great value when casting aluminum, as the temperature of the metal can then be accurately gaged, and overheating avoided. The best temperature at which to pour aluminum into sand molds, has been found to be 1,200 degrees Fahr.

PROBLEMS OF THE BRASS FOUNDER

What To Do and How To Do It

Casting Lightning Rod Points

We are casting lightning rod points, 5 feet long and 1 inch in diameter, from a mixture consisting of copper, 98 per cent, and zinc, 2 per cent. The castings are gated about 10 inches from one end at the side, the mold being tilted for pouring and after casting, the mold is immediately lowered onto a level bed of sand. However, the castings crack near the middle and we have been unable to overcome this difficulty.

If the castings can be gated at one end instead of at the side, cracking will be reduced materially. The mold should be inclined approximately 8 inches at the sprue end and it is not necessary to lower it to a horizontal position after it has been poured, provided one end is free to contract. The tendency to crack can be controlled by changing the deoxidizer and instead of using 2 per cent zinc, 1 per cent of 10 per cent silicon-copper should be employed.

Expanding Pattern Metal?

What mixture of pattern metal will produce castings slightly larger than the original patterns?

There is no known metal or alloy that will produce castings larger than the pattern from which the mold is made. All metals, on the other hand, produce castings smaller than the pattern on account of their shrinkage properties. Occasionally, castings can be made slightly larger than the pattern by ramming the mold soft and by rapping the pattern well before withdrawing it from the sand, but it is obvious that the successful application of this practice is restricted to plain shapes.

Anti-Corrosive Mixture

We would like to have a mixture that will satisfactorily withstand the corrosive action of salt water.

According to the ninth report of the Alloys Research Committee of the British Institution of Mechanical Engineers, a 10 per cent aluminum bronze immersed with samples of other alloys in sea water for a period of 639 days showed a loss in weight of 0.020 per cent per month, amounting to a loss of 0.00081 pound per square foot for the same period. Naval brass subjected to the same test showed a loss of 0.00124 pound per square foot per month and Muntz metal showed a loss of 0.0023 pound per square foot per month. According to this test it would seem that any of these alloys would give good results when subjected to salt water. The

composition of naval brass used for spindles and pump rods follows: Copper, 67 per cent; zinc, 32 per cent, and tin, 1 per cent. Muntz metal contains from 56 to 63 per cent copper and 44 to 37 per cent zinc. If a phosphor bronze is better adapted to your work, we recommend the following mixture: Copper, 90 pounds; tin, 5 pounds, and phosphor tin, 5 pounds.

Flux for Aluminum Alloy

Kindly advise me whether sal-ammoniac and common salt can be used as a flux for a pattern alloy consisting of two parts aluminum and one part zinc.

There is no reason why a mixture of sal-ammoniac (ammonium chloride—NH_4Cl) and common salt (sodium chloride NaCl) cannot be used as a flux for the aluminum-zinc alloy with fairly good results. However, for aluminum or its alloys the best flux that can be used is zinc-chloride—$ZnCl_2$. A piece of this flux the size of a hickory nut is sufficient for a No. 40 pot full of molten aluminum. The zinc chloride is thrown on top of the metal and is stirred into the dross on the surface of the aluminum. It acts as a separating medium on the dross and the metallic aluminum mixed therewith. The metal sinks into the bath and the dross remains floating on the surface of the metal in the form of a powder. The zinc-chloride, therefore, serves to save considerable metal that otherwise would be skimmed off in the form of a pasty mass. Sodium chloride has a similar action upon aluminum, but in a lesser degree. Potassium nitrate (KNO_3) commonly known as saltpeter, also is an excellent flux for aluminum, being superior to sodium chloride, but inferior to zinc chloride for this purpose.

Bronze Sleeve Lining

We are lining cast iron sleeves with bronze, approximately ⅜ inch thick, but we find it almost impossible to machine the bronze. The mixture we are using consists of copper, 80 parts; zinc, 8 parts; lead, 8 parts; tin, 3 parts, and phosphor tin, 1 part.

We can see no reason why the bronze you mention should not machine easily, as it contains a considerable percentage of lead. The fact that it is cast in an iron sleeve will have no effect on its hardness, as the latter is influenced solely by the tin content. As an experiment, it might be well to lower the tin addition from 1 to 2 per cent. This will produce a softer alloy.

Making McAdamite Metal

Kindly furnish us with a mixture for McAdamite metal.

McAdamite metal is an aluminum-zinc alloy containing zinc varying in percentage from 6 to 27, and for this reason it would be more appropriate to refer to McAdamite alloys than to McAdamite metal. A strong aluminum alloy follows: Aluminum, 82 pounds; copper, 3 pounds, and zinc, 15 pounds. This should be cast in the usual manner and the alloy will develop the same strength as the McAdamite metals, which owe their superior qualities more to careful melting and molding than to the formula of the alloy.

McAdamite metals are cast in molds consisting of a mixture of carbon, carborundum and French clay. The casting is chilled rapidly and the same results as to the density and strength of the metal are obtained as when casting the alloy in iron molds. In addition, this alloy is melted with great care to avoid overheating.

During a recent discussion of aluminum before the Society of Automobile Engineers, at Detroit, J. P. Carritto, general manager of the United States McAdamite Metal Co., stated that when aluminum attains a medium cherry red in the furnace it should be drawn and poured. This temperature, he said, ranges from 1,300 to 1,400 degrees Fahr., and if the heat must be held back temporarily, the metal should be covered with charcoal to prevent oxidation. When ready to draw the crucible, flux well with sal-ammoniac or chloride of zinc, using ½ ounce to a 25-pound heat and 1 ounce to an 80-pound heat. The flux should be forced to the bottom of the crucible, the metal should be stirred thoroughly, skimmed, drawn and poured immediately. The top of the metal should be cleaned of dross or dirt with a hardwood stick.

Great care should be exercised in the use of scrap and the gates, sprues and defective castings only should be employed. Turnings, filings, etc., never should be used as they are liable to contain iron, which is injurious to the metal. Because of its low specific gravity aluminum castings require comparatively large gates and sprues. Wherever possible, the metal should be fed-up from large gates in the bottom of the mold, thereby eliminating blow-holes and carrying the dirt and air to the tops of the risers. The crucible should be emptied after each heat unless another heat is to be made immediately, when four or five pounds of metal may be left in the pot. As the brittleness of aluminum increases with remelting, the percentage of left-over metal should be reduced as low as possible. Sharp corners in patterns should be filleted and heavy lugs should be chilled to prevent cracks and shrinkage.

Mr. Carritto stated that aluminum and its alloys is an interesting study, particularly in its elements of uncertainty and the greater the experience in handling it, the more it will be realized that there is much still to be learned regarding its possibilities. In his experience, a pot of aluminum frequently had been alloyed properly, fluxed, stirred, cleaned and skimmed, drawn by pyrometer, poured into two similar molds, side by side, from the same heat and at the same time; yet widely varying results were obtained in the strengths of the metal poured in the two molds. When melting aluminum special graphite crucibles should be employed, as this white metal has a great affinity for iron and silicon and for this reason iron skimmers should be avoided and all stirrers, pots and ladles should be well chalked or rubbed with graphite.

Porous Acid-Resisting Metal

We are making castings, 42 inches in diameter and 1½ inches thick, from acid-resisting metal of the following formula: Copper, 88 per cent; lead, 10 per cent, and tin, 2 per cent; 0.5 per cent of phosphor-copper is added to this mixture. The castings, however, are porous and we would like to know how we can overcome this difficulty.

To prevent porosity in this case, add 0.5 per cent of manganese-copper to the molten copper prior to the addition of the remainder of the charge. The surface of the metal should be well covered with a layer of charcoal and when the copper appears blue and limpid underneath this charcoal cover, add the tin, stir thoroughly and follow with the lead. If too hot to pour, cool with gates to the proper casting temperature.

Aluminum Casting Difficulties

We are experiencing considerable trouble in the manufacture of aluminum castings. They contain small spots about ⅛ inch in diameter and we are of the opinion that these are caused by small particles of vegetable matter in the sand we are using.

If the trouble outlined is caused by the presence of organic matter in the sand, a remedy can be easily applied. The molds should be faced with sand that has been well burnt. This can be accomplished by filling the old pots with new sand and placing them in the furnace after the heats have been withdrawn, permitting them to remain in

the furnace over night. If oil furnaces are used, some other means might have to be resorted to to accomplish this result. Several trial heats of molds faced with burnt sand should definitely decide whether organic matter in the sand is the cause of your difficulty. When the sand is subjected to the heat of the furnace, all organic matter is carbonized. In this connection, attention may be directed to the fact that the use of a fine wire frequently will cause small holes to appear both in aluminum and red brass castings of thin section.

Satisfactory Mixture for a Jobbing Foundry

By W J Keep

Question: We operate a jobbing foundry, but the bulk of our castings are intended for machinery work. We are anxious to cheapen our mixture. At the present time we are using 200 pounds of silvery pig containing 7 per cent silicon; 700 pounds of southern pig containing silicon, 2.75 per cent, and phosphorus, 1.25 per cent; 400 pounds of northern No. 2 containing 2.25 per cent silicon; 500 pounds of return sprues and scrap and 200 pounds of foreign machinery scrap. When our heat is about half off, we leave out the 200 pounds of silvery and substitute No. 2 foundry.

Answer: A good grade of northern iron is made in your own city and another furnace in your immediate vicinity also makes No. 2 foundry, which is practically the same as that produced by your local stack. As the pig iron made by the furnace near your city is machine cast, this is to your advantage, and as you successfully use this iron, there is no reason why it should not be continued in your mixture. The furnace in your city makes various grades of iron at different times, including malleable, an imitation of southern iron which you are using and standard foundry iron. You can readily appreciate that when the furnace is changing from one grade of iron to another the output will not correspond with any of the company's brands and that it will hold this iron until customers are obtained for these off grades. If the sulphur is not over 0.05 per cent, the phosphorus below 0.70 per cent and if the silicon is sufficiently high, such an iron would meet your requirements. Occasionally, such iron can be obtained containing as high as 3 per cent silicon at a price not in excess of that paid for standard No. 2. The southern iron in your mixture, which contains 1.25 per cent phosphorus, should never be used for strong castings. Formerly, this iron was sold at a lower price than standard grades and, therefore, was used quite extensively for light castings. Silvery iron in a machinery shop should only be used in an emergency and solely for its silicon content. It is advisable, however, to have a carload of good silvery iron in the yard when required. For machinery castings the silicon should be kept as low as possible, but should be sufficiently soft to permit of easy machining. The heavier the castings, the lower should be the silicon content. If you purchase a good grade of northern foundry iron, the sulphur and phosphorus will be sufficiently low to cause you no difficulty but the silicon should be of the guaranteed percentage. For your work, your castings should contain approximately 2 per cent silicon and iron having 2.25 per cent silicon will prove satisfactory.

The Use of Scrap

A sufficient amount of good machinery scrap should be used with your shop scrap to make one-half of the mixture and you might be able to increase this proportion. The only danger in the use of scrap is that its sulphur content may be higher than desired. The sulphur in the coke should not exceed 0.80 per cent. As you are now obtaining good castings, the change in your mixture should be made gradually. If your customers report that the castings are too hard, the silicon content should be slightly increased. However, if the castings contain spongy spots, the silicon should be lowered.

You state that you use silvery iron in the first charges, the metal from the first part of the heat being poured into bench work and light castings and no silvery iron is added to the mixture in the last part of the heat, which is poured into machinery castings. If you find that this is necessary, the sprues and scrap containing a comparatively high percentage of silicon should be mixed with the first charges and the low silicon sprues should be added to the last charges. In any event, the silicon percentage in your castings should be determined by analysis. Also, a shringage test will indicate each day whether the silicon is too high or too low. For your work, the shrinkage should be about 0.14 inch per foot and this might be increased without danger as high as 0.16 inch. When you ascertain the proper shrinkage point and if this should increase, add silicon to your mixture, and if the shrinkage decreases, lower the silicon content.

If you desire to figure the silicon in your mixture, you must first ascertain the silicon in each iron that composes the mixture. The furnace furnishing the iron undoubtedly will forward an analysis of each car and you can figure the foreign machinery scrap as containing 1.75 per cent silicon. Then multiply the pounds of each kind of iron by the percentage of silicon in each and the product can be termed pounds of silicon, although it is multiplied by 100. Add the pounds of iron and pounds of silicon and divide the silicon by the quantity of iron in the charge and you thus obtain the percentage of silicon in your mixture. As there will be a loss of 0.20 per cent silicon in melting, your mixture should be increased by this percentage of silicon. If you desire to obtain castings containing 2 per cent silicon, the problem should be figured as follows:

Sprues and shop scrap	500 × 2.00 =	1,000.00
Foreign scrap	500 × 1.75 =	875.00
No. 2 foundry.....	400 × 2.25 =	900.00
1,400	÷	2.775.00 = [1.98 per cent

Allowing 0.20 per cent for loss, you want 2,000 pounds of iron containing 2.20 per cent silicon = 4,400.00, and subtracting 2,775 pounds already contained in the 1,400 pounds of your mixture, you will require 1,625 of silicon. Therefore, 600 pounds of iron containing 1,625 of silicon must be obtained. Dividing 1,625 by 600 gives you 2.71 per cent. If you have an iron in the yard containing 2.70 to 3 per cent silicon, use 600 pounds of this grade.

On the other hand, if you should have only No. 2 foundry and silvery iron containing 7 per cent silicon for emergency, you can calculate your mixture as follows: As the No. 2 foundry contains only 2.25 per cent silicon and you desire 2.71 per cent silicon, therefore you require an additional 0.46 per cent in your mixture. The silvery iron contains 7 per cent silicon and as you desire only 2.71 per cent, there is an excess of 4.29 per cent silicon in the silvery iron. Adding 429 and 47, we have 476 parts of 600 pounds. Dividing 600 by 476 gives 1.26 for one part. Therefore multiplying 1.26 by 429 equals 540 pounds of No. 2 foundry iron and multiplying 1.26 by 47 gives 60 pounds of silvery iron required.

A Latter-Day Stove Shop

Isaac A. Sheppard & Co.'s finishing building and foundry

Its Equipment for Fine Casting Production

By Edgar C Kreutzberg

WHEN preparing plans for a new plant, many factors must be considered to insure economical operations. It is essential that all the latest and best ideas be embodied, since improvements that are being made constantly in equipment and practice make it difficult to keep even a new plant entirely up-to-date for an extended period. The feature of primary importance is the arrangement of the departments in such a manner that the product, in its conversion from the raw to the finished state will pass through the various operations with the least amount of handling. In brief, it is necessary to "build the plant around the process" rather than to install the machinery to fit the plant.

When Isaac A. Sheppard & Co. built their new plant at Philadelphia last year, they applied the most practical ideas gathered during two generations' experience in the stove founding business. The preparations for constructing the plant consumed more time than the actual building operations and the architects, William Steele & Sons Co., Philadelphia, prepared five sets of drawings before the plans were finally approved. As a result, the plant is one of the best arranged and equipped of its kind in the country. That manufacturing economies have been effected is indicated by the fact that the cost of production is 5 per cent less than in the old shop.

The plant is located in the Kensington section of Philadelphia, adjacent to the Pennsylvania railroad's Kensington branch. The site covers two city blocks, although a street bisecting the property has never been opened.

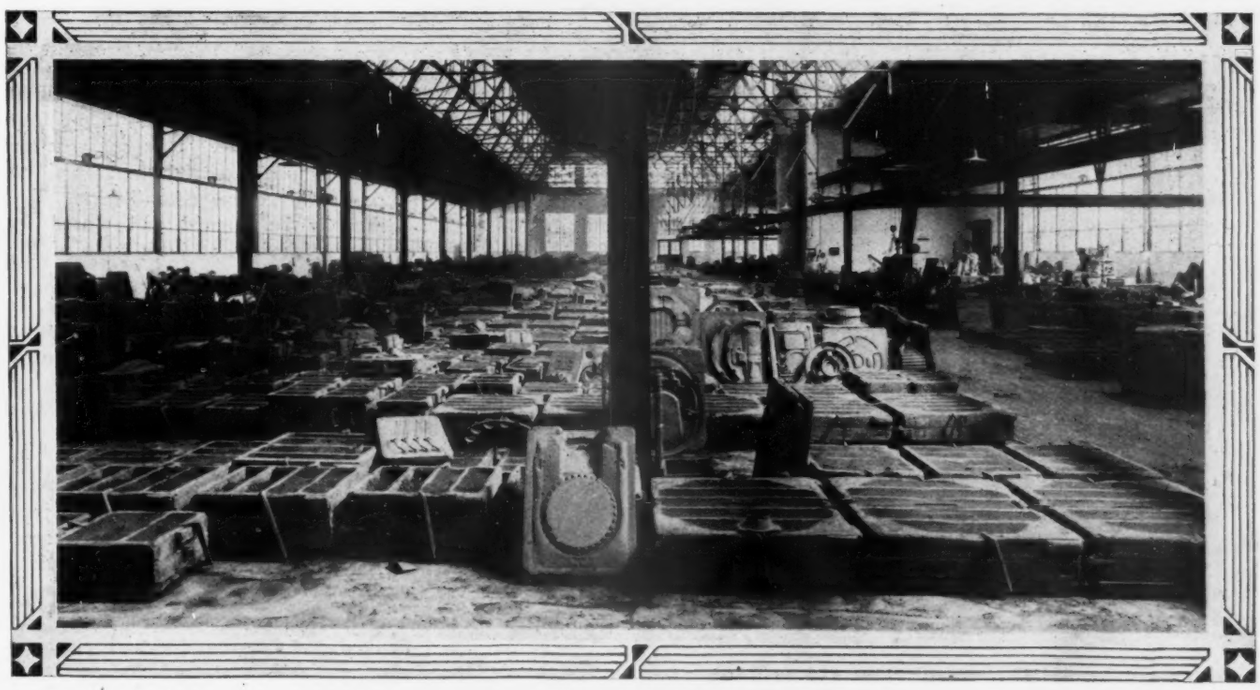
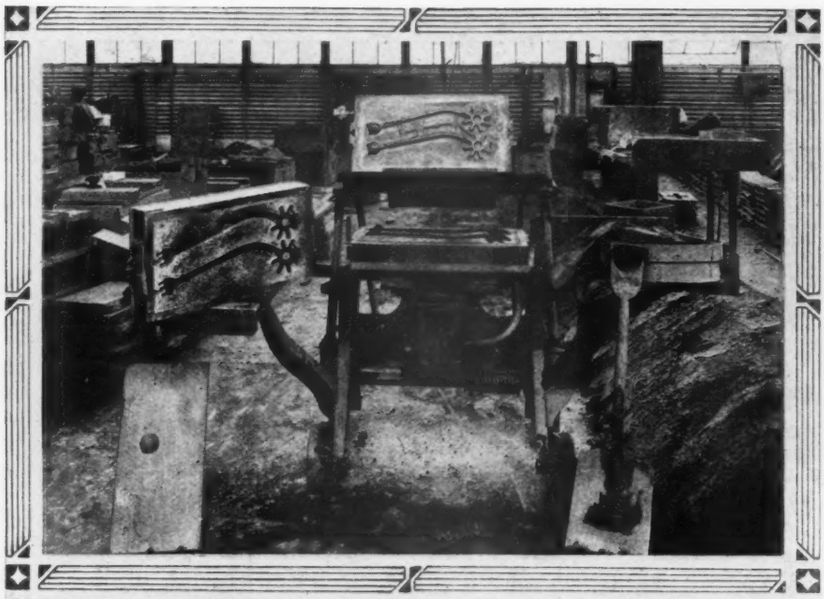


FIG. 1—INTERIOR VIEW OF THE SHEPPARD STOVE FOUNDRY



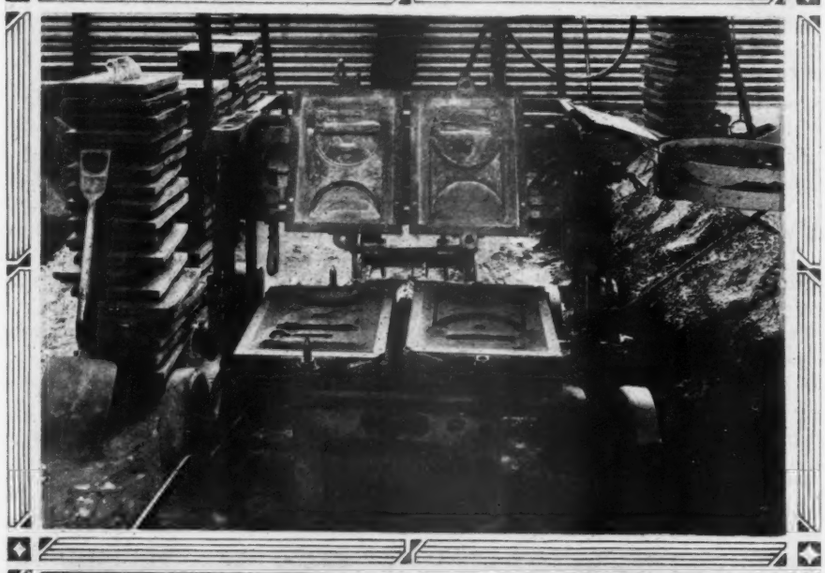


FIG. 2—POWER SQUEEZER EQUIPPED FOR MOLDING GAS RANGE BURNERS
FIG. 3—MODERN MOLDING MACHINE EQUIPPED FOR MOLDING A STOVE CENTER AND DAMPER HANDLE
FIG. 4—ONE OF THE PORTABLE STEEL MOLDING BENCHES

The eight buildings constituting these works have a combined floor area of approximately 141,000 square feet. The finishing and storage department is located in a three-story building, 82 x 241 feet, of reinforced concrete construction. However, instead of carrying the floors on concrete beams and girders, the reinforcing is arranged in the form of flat slabs to support the floors. This type of construction permits of wide spacing between columns. The floors are designed for a live load of 120 pounds and the roof for 30 pounds per square foot. The roof is made of concrete, covered with slag. The exterior lintels, which are exposed, are inverted, and the bottoms of the lintels thus are on a level with the bottoms of the floor slabs and the windows are carried up to the ceiling, providing a maximum window area. The windows are encased in steel sash furnished by the David Lupton's Sons Co., Philadelphia. Throughout the building, fixtures are permanently embedded in the concrete ceilings, from which shafting, motors, etc., may be suspended where required.

The Foundry

The foundry is 107 x 274 feet, the walls being of concrete and brick construction. The roof is supported by steel trusses and columns, the bottom of the trusses being 23 feet above the floor level. The roof construction is illustrated in the cross-section of the foundry building, Fig. 22. It will be noted that the center line of the monitor is depressed and this design deflects the smoke and gas to the ventilators in the sides of the monitors. The monitors are provided with eight rows of Pond continuous sash, four rows on each side. This construction insures ample natural light as well as exceptionally efficient ventilation. The sash may be opened and closed by operating devices at both ends of the foundry.

The cleaning room, 107 x 71 feet, is of brick construction with cement floors. The roof of this building is of the saw-tooth type, one side being covered with continuous sash. The supply building is 34 x 74 feet, two stories high. The wash-house is 20 x 62 feet, two stories, and the power house is 47 x 67 feet. The pattern shop and core department are located in two-story buildings, 42 x 142 feet each.

The raw material storage yard is flanked by the foundry and cleaning shop on one side and by the core and pattern shops, the wash-house and the power plant on the other. The

storage yard is paved with Belgian blocks and is served by a side track from the Pennsylvania railroad.

A rather unique feature, for a modern foundry, is the absence of an industrial railroad in the storage yard. Instead of the usual narrow-gage track, the yard is provided with flat, portable tracks, over which the iron is pushed in wheel-barrows to the elevator, which communicates with the cupola charging floor. These tracks are made of cast iron plates, 1 foot wide, 5 feet long and ⅝ inch thick, laid end to end. The advantage claimed for this track is that it may be extended easily to any part of the yard, and thus the iron may be loaded directly into the wheel-barrows instead of having to be carried a short distance, as is generally the case where the usual industrial track and flanged wheel trucks are used. The coke and scrap are similarly handled.

Pattern and flask lumber is unloaded from cars on the incoming track, directly into the lumber storage shed, adjacent to the pattern shop. Coal for the boiler room is dumped through man-holes between the tracks, which open directly into a coal vault.

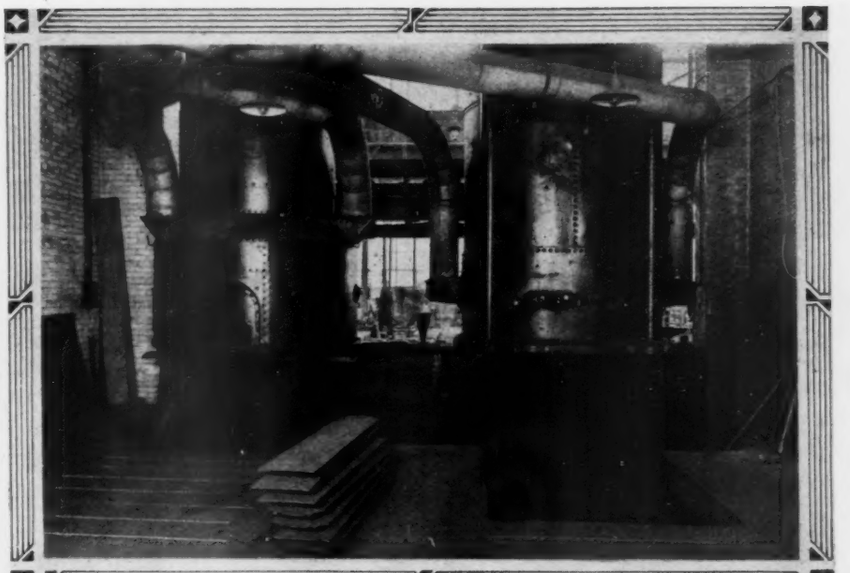
Sand Storage

The molding sand and fire clay are stored in a reinforced concrete bin, underneath the surface of the yard. This bin is served by the cupola elevator, as well as by an inclined passageway from the yard. The sand is discharged from cars on the incoming track into the underground bins through man-holes in the roof of the bin. The bins are steam-heated to prevent the freezing of the sand in cold weather.

Opposite the underground sand storage bin, and connecting with the latter by a reinforced concrete tunnel, is the basement of the core building, which likewise is used for the storage of sand. The core sand is discharged from the cars into the basement through concrete chutes, the openings of which are on a level with the floor of the freight car. When not in use, the openings of these chutes are covered with steel doors.

The cupola house is 28 x 42 feet. The charging floor is covered with steel plates, supported by I-beams. The iron is melted in two cupolas, one being of the Paxson-Colliau type, while the other was built many years ago, according to specifications prepared by Franklin L. Sheppard.

This cupola is elliptical in cross-section and was designed on the theory that with a blast pressure of 18 ounces, this form of construction



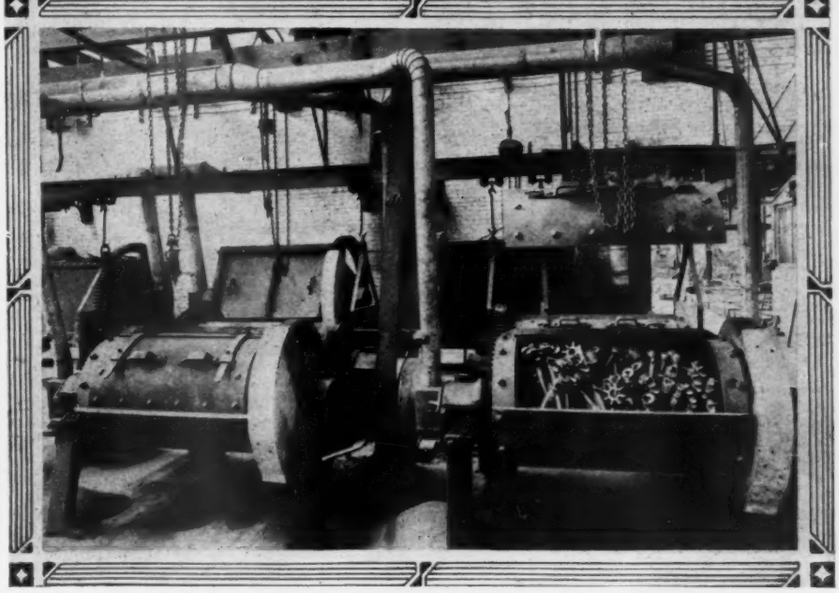


FIG. 5—THE TWO CUPOLAS, THE ELLIPTICAL STACK AT THE RIGHT
FIG. 6—THE CLEANING ROOM, SHOWING THE TRAMRAIL CONNECTIONS
FIG. 7—BATTERY OF WHITING TUMBLING BARRELS; THE COVERS ARE HANDLED BY HOISTS

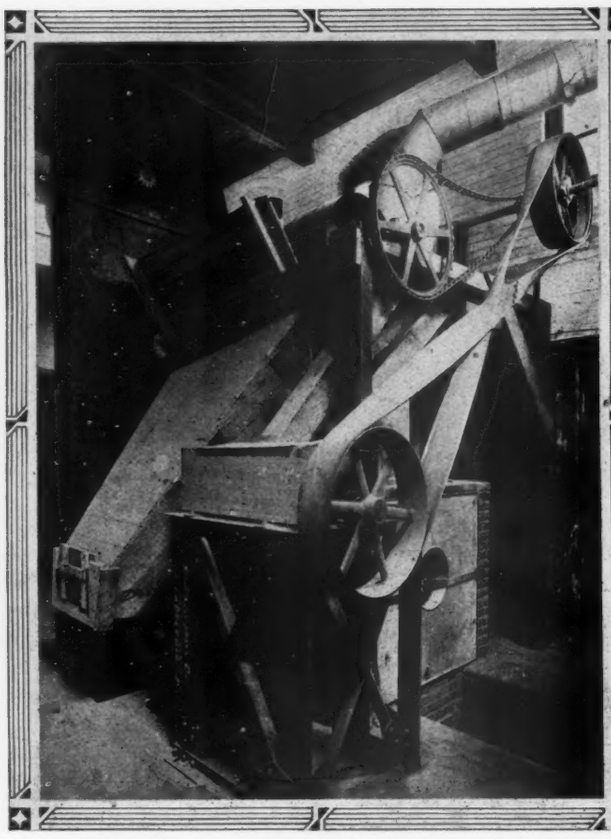


FIG. 8—MACHINE FOR DRYING, CRUSHING AND SCREENING MOLDING SAND

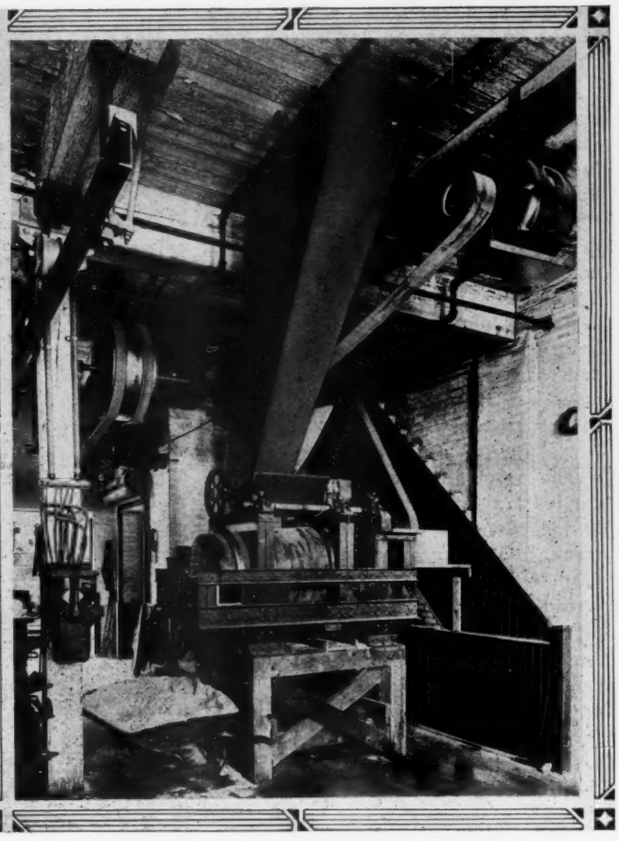


FIG. 9—SPECIAL MACHINE FOR MIXING SAND FOR CORE DEPARTMENT USE

would have a tendency to make the center of the cupola the region of greatest heat intensity. The tuyeres on each side are located so as to direct the blast toward the two axes of the ellipse. The blast thus meets at these points, being deflected along a straight line connecting the two axes. Thus, theoretically, the region of most intense combustion in this cupola is in an imaginary plane passing vertically through the two axes of the ellipse. The cupola is of the bosh type, having an internal air chamber, thereby reducing the travel of the blast as compared with that of a blast belt externally located. The external diameters of the cupola are 82 and 61 inches, and the diameters inside the blast chamber are 71 and 50 inches, inside the lining, 59 and 38 inches, and the inside diameters above the hearth are 73 and 52 inches. The cupola has been operated successfully for 16 years. Blast is furnished by a blower, built by the Wilbraham-Green Blower Co., Pottstown, Pa., which is operated by a 40-horsepower motor, controlled by a Westinghouse, street railway type, reversible starter, provided with a six-coil resistance. Thus the blower may be operated at seven different speeds, producing air pressures ranging from 8 to 24 ounces. The starter is so located that the cupola tender can watch the pressure gage and the spout of the cupola without leaving his station. The blast pipe leading from the blower to the tuyeres of both cupolas may have either of its branches open to operate one cupola, or both may be operated simultaneously. For controlling the operations of the smaller cupola, a separate starter is provided, which may be used in case of emergency. A 25-horsepower motor has been installed for operating the blower serving the smaller cupola in the event of the stoppage of the large motor.

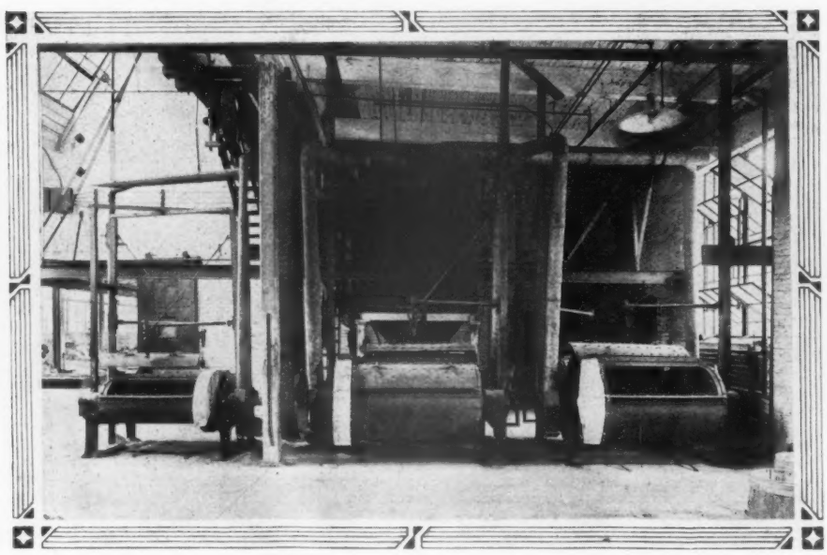


FIG. 10—ANOTHER BATTERY OF TUMBLING BARRELS, SHOWING HOW THE COVERS ARE HANDLED

Underneath each of the cupolas are pits, Fig. 5, into which bottom is dropped. Communicating with these pits are two inclined runways for wheeling away the slag after it has

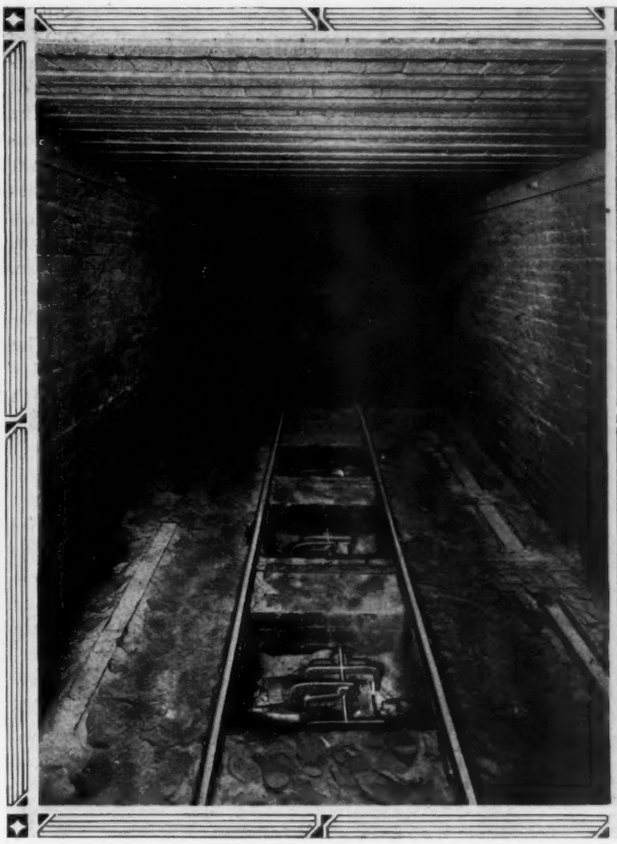


FIG. 11—INTERIOR OF CORE OVEN, SHOWING SLIDES FOR REGULATING SUPPLY OF HEATED AIR

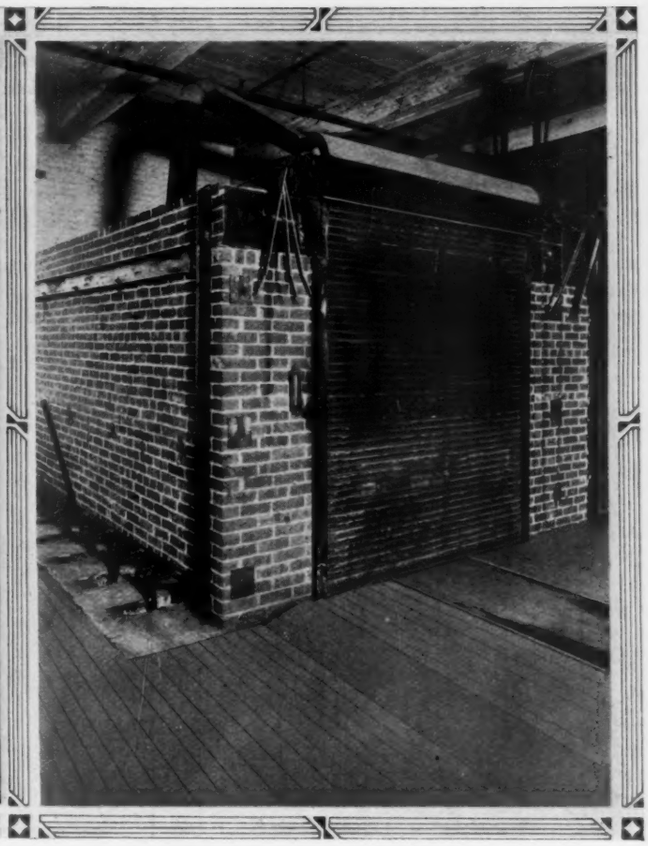


FIG. 12—SPECIALLY-DESIGNED CAR OVEN, SHOWING LEVERS FOR REGULATING DAMPERS

been cooled and broken up. When not in use, these pits are covered with cast iron plates. For grinding the slag and milling the gates from the foundry, two tumbling barrels, 3 x 6 feet and 2½ x 5 feet, respectively, operated by a 10-horsepower motor, have been installed. Gates and slag are loaded into the barrels together, the former, while being cleaned, crushing the latter. In this manner the iron and coke are recovered from the slag.

Melting Operations

The charging floor is served by an electric elevator. As the coke, iron and scrap charges for each day's heat are stored on this floor, it has been designed to carry a load of 450 pounds per square foot, with a safety factor of 900 pounds.

For making the cupola breast, the Sheppard company employs a special split brick. When making the bottom, the sand is rammed in the hearth for building up the breast. The special brick, which has a semi-circular hole of ⅜ inch radius, cut across the bottom, is then laid in the hearth, being tightly wedged in place by pieces of scrap iron and broken brick. Since using this special brick, the Sheppard company has never suffered the loss of a heat due to a broken hearth.

For igniting the coke bed, a fuel oil burner built by the Hauck Mfg. Co., 90 West street, New York, is employed. This is applied for a period of about 10 minutes. When repairing the lining of the cupola, a circular screen, of the same diameter as the furnace, is placed inside to safeguard the repair man from falling brick and pieces of lining that may work loose. The screen is built in sections to permit it to be passed through the charging door.

The floor of the foundry is concrete, with the exception of a small area, 33 x 35 feet, devoted to loam and pit molding. The foundry, a view of which is shown in Fig. 1, contains 92 molding floors, of which 62 are used

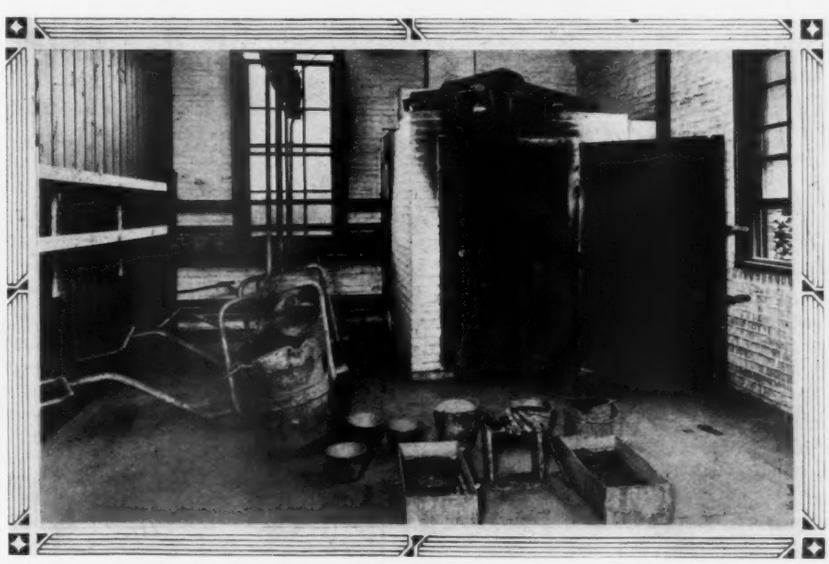


FIG. 13—WHERE THE LADLES ARE LINED AND THE FURNACE IN WHICH THEY ARE DRIED

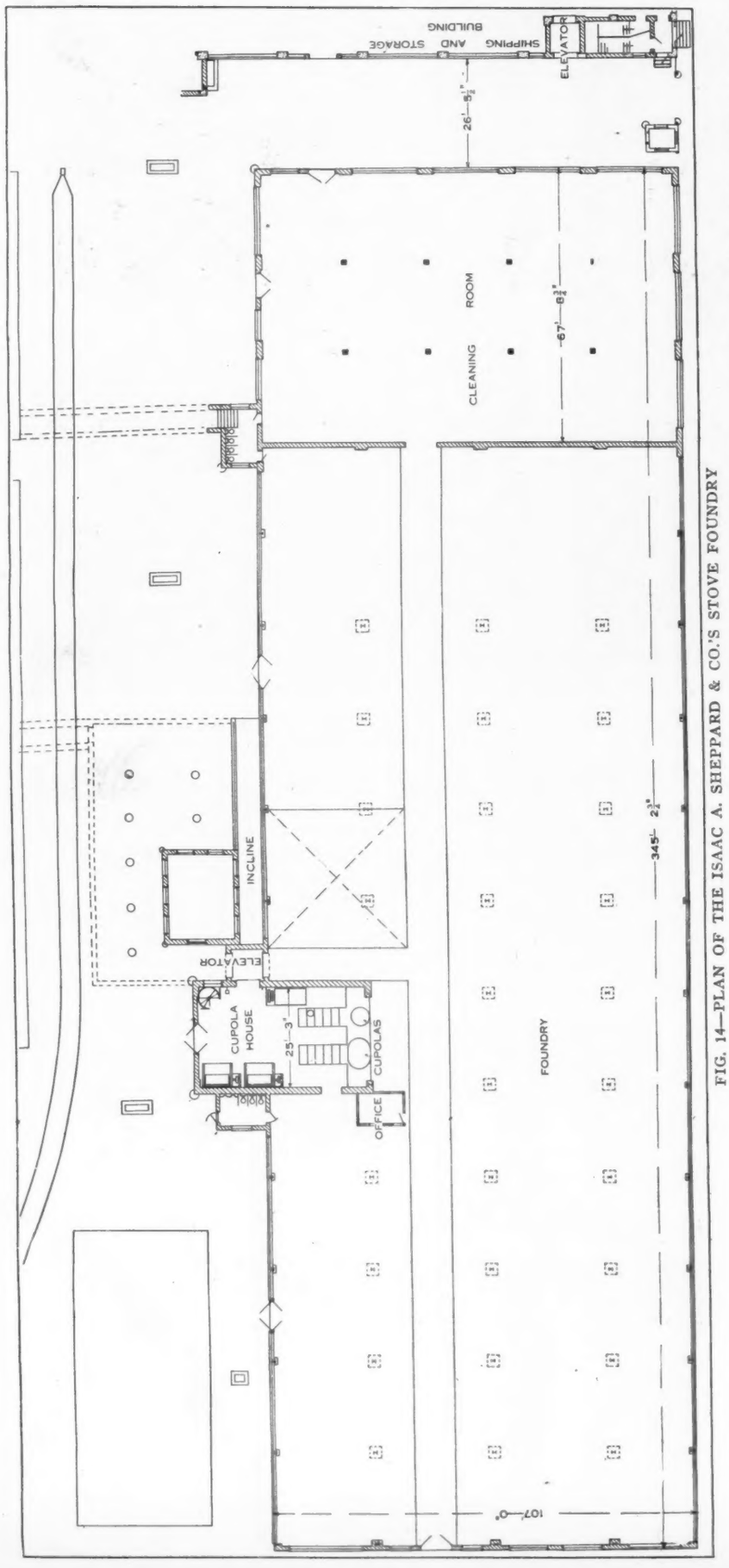


FIG. 14—PLAN OF THE ISAAC A. SHEPPARD & CO.'S STOVE FOUNDRY

for floor work and the remainder for bench work. These are laid out according to a system of economy of space, which has been evolved by the Sheppard company as a result of experiments made at its Baltimore plant 10 years ago. Each bench floor is 6 feet wide and 35 feet long, being located along one side of the foundry, on either side of the cupola house. The floors for large work are 60 feet long and of widths suitable to the needs of the molds being made. The average width for single floors is 4½ feet and the most economical width for double floors is 9½ feet. The gangway extending the full length of the shop is 10 feet wide.

The foundry is equipped with an overhead trolley system installed by the Randall Tramrail Co., Philadelphia, which extends the length of the shop and delivers the bull ladles to the ends of the floors, where the molders receive their iron in hand ladles. This overhead system also is provided with trolley trucks for delivering the castings to the cleaning room. The foundry also is provided with six electric cranes, two having capacities of two tons each, and four, one ton each. These are of the transfer type and were built by the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. The molding benches are of steel construction, 19 having been furnished by the Western Tool & Mfg. Co., Springfield, O. One of these benches is shown in Fig. 4, the steel pipe legs mounted on four wheels spanning the sand heap. Each bench is equipped with a knee pad vibrator.

Machine-Molded Stove Plate

The foundry was primarily arranged for machine-molding operations, but because of labor difficulties, molding machines have not been extensively installed. At present only six machines are in operation, including two Adams power squeezers, two Arcade hand-power machines, one Arcade power machine and one Davenport squeezer. Two of these machines are employed for molding stove plate, the others being used for other work.

The two machines on which stove plate is molded and which are operated by apprentices, are shown in Figs. 2 and 3. Fig. 2 illustrates an Arcade power squeezer equipped for making long top burners for gas ranges. The patterns are mounted on a match-plate, the drag being rammed and rolled over, after which the cope is made. On this machine 80 molds constitutes a day's output. Fig. 3 shows a Modern molding machine equipped for making both a cross-piece shield and a damper handle in one mold.

Both cope and drag are made in one operation. A day's work on this machine is 178 molds.

The foundry is provided with a portable sand sifter, built by the Arcade Mfg. Co., Freeport, Ill., which makes the rounds of the entire foundry once a week in order to remove nails, scrap, etc., from the molding sand.

A special machine for treating molding sand, built by the Standard Sand & Machine Co., Cleveland, is shown in Fig. 8. The sand first is shoveled into a revolving cylinder provided with blades, by means of which the sand is carried up and dropped, once for each revolution of the cylinder. Through the center of the cylinder extends a cone-shaped distributor. Thus the sand, as it falls onto the distributor, flows down either side and is deposited in the cylinder between the blades, which project into its interior. The cylinder is heated by a coke fire, the furnace being located in a pit. The cylinder, whose axis is inclined, rotates at the rate of 16 revolutions per minute, and the sand, as it falls back on the distributor at each revolution, advances gradually toward the end, where it is discharged into a pit through a chute. From this pit the sand is delivered by a link-belt conveyor to a cylindrical, revolving inclined screen which operates at the rate of 32 revolutions per minute. The fine sand, as it is passed through the screen, falls into a hopper, which discharges into wheelbarrows. The tailings travel along the interior of the screen, falling out of the end into a chute, leading to a pair of rolls which operate at the rate of 24 revolutions per minute. After the tailings have been crushed they are discharged into a pit at the boot of the conveyor.

The object of this sand treating process is two-fold. First, it is desirable that the sand should be of a uniform grain and that it should contain no gravel or coarse particles. Secondly, it has been found that by heating and drying the sand before it is used the organic matter in it is destroyed, so that less gas and vapor are generated in the mold, and, hence, less venting is necessary. The heat to which the sand is subjected is only sufficient to dry out the organic matter and the moisture without destroying the bond. The cupola elevator delivers the prepared sand to the foundry.

The cleaning room is well-equipped and the practice is modern in every particular. The good castings, as shown by the gangway count, are delivered to the cleaning room on trucks suspended from the trolley. After cleaning, the defective castings, known as the cleaning room scrap, are set aside to permit the molders to examine them. The good castings are finished and delivered to the mounting department in matched lots for one stove. When a few of the parts for a complete stove are missing, the castings already made are stored temporarily on shelves in the cleaning room. This method of handling castings was adopted to keep the mounting room free of spare parts. The cleaning department account shows the weight of all castings received from the foundry, the weight of good castings sent to the mounting room, the weight of scrap returned from the mounting room and the weight of all scrap returned to the cupola department.

The exhaust tumbling mills were fur-

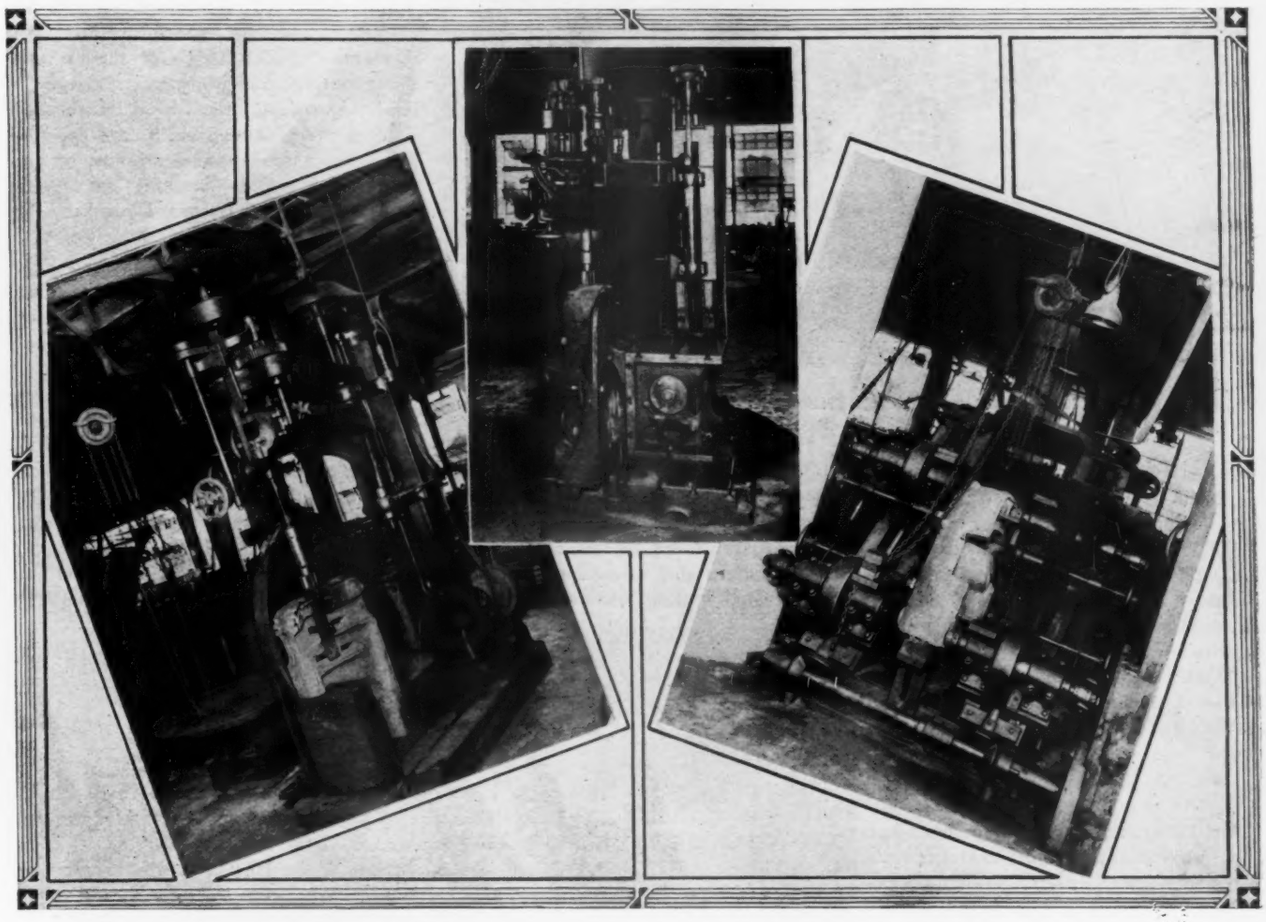


FIG. 15—ROUND AND FLAT BOILER SECTION, RADIAL DRILLING AND TAPPING MACHINE

FIG. 16—FIVE-FOOT RADIAL DRILLING AND TAPPING MACHINE

FIG. 17—SPECIAL MACHINE FOR BORING NIPPLE HOLES IN BOILER SECTIONS

nished largely by the Whiting Foundry Equipment Co., Harvey, Ill., and include one 48 x 48 x 64-inch and two 42 x 42 x 64-inch square tumblers, two 36 x 59-inch, four 24 x 35-inch, two 20 x 42-inch and four 34 x 54-inch round barrels. These machines all are

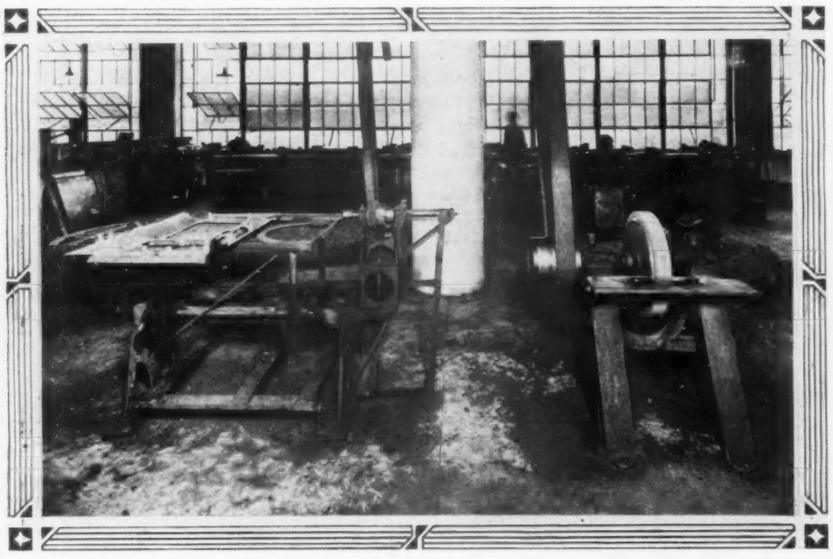


FIG. 18—SPECIAL DRILLING LATHE AT THE LEFT, AND A GRINDING STAND, AT THE RIGHT

provided with guards to protect the workmen from exposure to the gears. For handling the covers of the Whiting barrels, differential chain hoists of the Yale & Towne type are used. The cleaning room also is provided with three emery wheel stands, which are belt-driven by a five-horsepower motor. For operating the tumbling barrels, one 15-horsepower, two 10-horsepower and one 7½-horsepower motors are provided.

Ladle Lining Room

For lining ladles a special room has been provided, the bull ladles being delivered to this department by an extension of the overhead foundry trolley system. The linings of the large ladles are partly baked on the floor of a special oven, Fig. 13, after which they are run outside, where the baking is completed by building fires inside of the ladles.

The hand ladles are baked in the oven, which was especially designed for this purpose. After lining, the ladles are placed on tables in a rack at one side of the oven. These tables, by means of rollers, may be moved along the rack into the oven, the opening being closed automatically. The rack is provided with three tables, each of which holds about 50 ladles. The oven is coke-fired through a door outside of the buildings. To regulate the temperature of the oven, seven flues have been provided, one in the roof and six in the walls.

The supply building contains a coke furnace for melting brass and aluminum for casting pattern plates and patterns.

A portion of the space on the first floor of this building is devoted to the storage of metal patterns, follow-boards, snap flasks, etc. Gas range patterns are stored on the second floor.

The pattern shop is equipped with the usual wood-working equipment, including a band saw, circular saw, turning lathe, trimmer, six pattern benches, etc.

The core mixtures are made in the basement where the core sand is stored. For a majority of the cores a mixture of washed silica sand and raw linseed oil, in the proportion of 40 parts of the former to one part of the latter, is used. Another mixture consists of equal parts of molding and silica sand, dry core compound being used as a binder in the proportion of 30 parts of sand to one of compound. Another mixture occasionally used consists of two parts of Jersey gravel to one of Lumberton sand, to which dry core compound is added in the proportion of 30 of sand to one of compound. For the greater portion of the work, however, the washed silica sand and linseed oil mixture is employed. The silica sand, after being mixed with the oil, is delivered to the second floor of the core shop by an elevator. On the second floor it is discharged into a steel chute, which conveys the sand into a sand mixing machine on the first floor. This machine was built specially for the Sheppard company by the Standard Sand & Machine Co., and is shown in Fig. 9.

The sand falls from the chute onto a revolving screw by which it is fed into a hopper and from which it drops into an inclined cylinder. The latter is 26 inches in diameter and four feet long and is provided with eight blades. Extending through the center of the cylinder is a pair of kneading rolls and through these the sand is passed as it falls between the blades at each revolution of the cylinder. As the axis of the cylinder is lower at the front than at the rear, the sand advances slowly until it is discharged. The sand passes through the rolls 19 times. The machine has a capacity for mixing 1½ to 2 tons of sand per day, and is driven by a 10-horsepower motor.

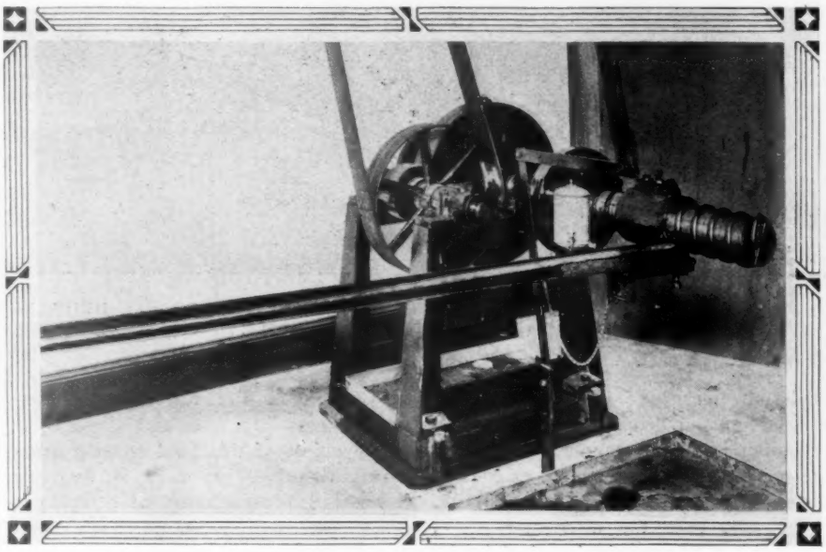


FIG. 19—MACHINE FOR COILING COPPER TUBING

For baking cores two large ovens, each 16 feet long, 9 feet wide and 6 feet high and three ovens of the drawer type have been installed. The car ovens, one being shown in Fig. 12, are provided with roller doors of the Kinnear type. As illustrated in Fig. 11, three openings in the floor of each oven connect with the main flues. These openings are covered by slides manipulated by levers at the side of the oven and the heated air may be directed to any part of the oven, as desired. To aid in regulating the temperature of the ovens thermometers are provided. To facilitate the handling of large cores, two hoists have been installed. The hoists are mounted on rails and may be moved along the floor both lengthwise and crosswise. The ovens are fired by two furnaces, one for the two large ovens and the other for the three-drawer ovens. Coke is used as fuel in the day time and coal at night, since the latter fire requires less attention than the former. Each of the drawers in the bureau ovens is provided with a dial, corresponding to the face of a clock. The hand is set to point to the time at which the cores are to be removed.

Cores made for immediate use are kept on the first floor in racks from which they are delivered to the foundry on tables. Cores for stock are delivered to the second floor by an elevator. The third floor is provided with a monitor roof for admitting light and air. Extending from the second floor are a number of galvanized iron pipes connecting with hoods located above the core oven doors. These pipes discharge the gases and smoke which they collect into the monitor. The core boxes which are used on regular work are kept on shelves on the first floor while those used only occasionally are stored on the second floor. The shop is equipped with a jar-ramming core machine built by the Wadsworth Core Machine & Equipment Co., Akron, O.

From the cleaning room the stove, heater and range castings are delivered to the mounting department to be machined and assembled. The machinery for finishing the heavy boiler sections is located near the entrance from the cleaning room to reduce to a minimum the handling of these large sections. From eight to twelve boilers, depending on the size and style of the heater, can be assembled and completed per day in the mounting department.

Many of the machines are of special types, having been designed particularly for this class of work. One of these is a three-foot radial drilling and tapping machine, Fig. 15, equipped with a plate that may be rotated 90 degrees to permit of drilling holes at any angle. The machine may be used for milling, drilling, reaming and tapping, but is especially adapted to drilling round and vertical boiler sections. These sections, which are handled by a chain hoist suspended from an overhead rail, are clamped to a heavy cast iron plate attached to the end of the angle plate hinges. After the vertical holes are machined, the end of the plate is lifted by the chain hoist, thereby bringing into a vertical position the holes which previously were horizontal. The machine is belt-driven by a six-horsepower motor.

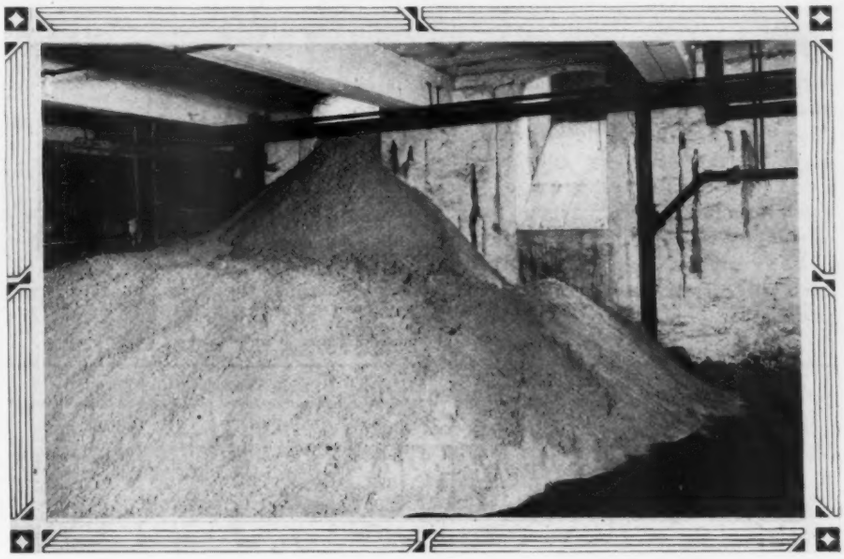


FIG. 21—SAND STORAGE IN BASEMENT OF CORE SHOP

FIG. 20—STOVE WAREHOUSE, SHOWING HOW REINFORCED CONCRETE SLAB CONSTRUCTION GIVES A MAXIMUM AMOUNT OF FLOOR AND HEAD ROOM

Boring Boiler Sections

For boring the nipple holes in hot water and steam boiler sections, the special machine shown in Fig. 17 is employed. The casting is held by clamps, while the cutter spindles are provided with automatic stops which cause them to be disengaged and to come back to their original positions as soon as the holes have been bored to size. This machine can be used on end sections having two holes, as well as on the regular sections which contain four holes. The sections are

lowered into place on the machine by a chain hoist. The machine is belt-driven by a six-horsepower motor.

For drilling, reaming and tapping circular and flat boiler sections, a five-foot radial machine, Fig. 16, is employed which is provided with vertical and horizontal tables to facilitate the machining of all holes in these castings. Both tables may be rotated to bring them into position for machining any hole in the section bolted to the horizontal table. The sections are transferred from one table to the other by a chain hoist suspended from a trolley on an overhead tramrail. This machine is belt-driven by a 7½-horsepower motor.

For drilling bolt holes in stove and range castings a number of drilling lathes, of a type designed by Franklin L. Sheppard 25 years ago, are used. The work is placed on a table, as shown at the left, Fig. 18, which slides longitudinally upon a steel frame, being held in the position desired by means of a pin and rack. The drill is placed in a chuck on the end of a horizontal spindle, the latter being moved longitudinally by a foot treadle, thereby bringing forward the drill to engage the work. When the pressure is removed from the treadle, a counterweight returns the spindle to its former position. The frame supporting the table may be moved vertically by racks and pinions. As a result of the vertical and horizontal movement of the table, work of any width or depth may be drilled.

Nipples used in assembling boiler sections are machined on a special lathe. The nipples are of the ball variety, the tool-block being pivoted at the rear and is provided with a circular, pinion-driven rack on its front end for feeding the work. The tool is moved into the work by a hand screw, a set screw being provided to regulate the depth of the cut. Attached to the back rest of the lathe is a point gage which may be swung over in order to check the radius of the nipples. This machine is belt-driven by a six-horsepower motor.

Emery Wheel Stands

The emery wheel stands in the mounting department reflect the care exercised in designing all of the equipment for this plant. One of these stands is shown at the right, Fig. 18, and it will be noted that the frame is unusually heavy, being constructed of steel bars, 4 inches wide and ⅝ inch thick. The spindle is 2⅝ inches in diameter and is supported in bearings 9 inches long. The work rest is cast iron and is adjusted by screws. A small section of the work rest immediately in front of the wheel is removable, to facilitate dressing the wheel.

The finishing department also is provided with a special machine for bending copper tubing into coils, for use in boilers and heaters. This machine, Fig. 19, is equipped with a pinion and gear-driven spindle, which rotates a mandrel with a spiral groove cut in its circumference. Saddling this mandrel is a loose journal which advances by means of a thread engaging the spiral groove; the rotation of this journal is prevented by an angle bar attached at one end, while the other end is held by a brace. When coiling a copper tube, which is supported by a steel angle at the side of the machine, the end is clamped to the end of the grooved mandrel. The machine is then set in motion and as the spindle revolves, the tubing is coiled in the groove. The machine is provided with mandrels for making both right and left-hand coils. After the coil has been cut, it is stripped off the mandrel by reversing the motion of the spindle.

In the gas range and stove mounting department a 5-horsepower motor operates two multiple drills and two drill presses for drilling burners, and two emery wheels. A 7½-horsepower motor operates a pipe-cutting machine, a drill press, one pipe-threading machine, one rod head-

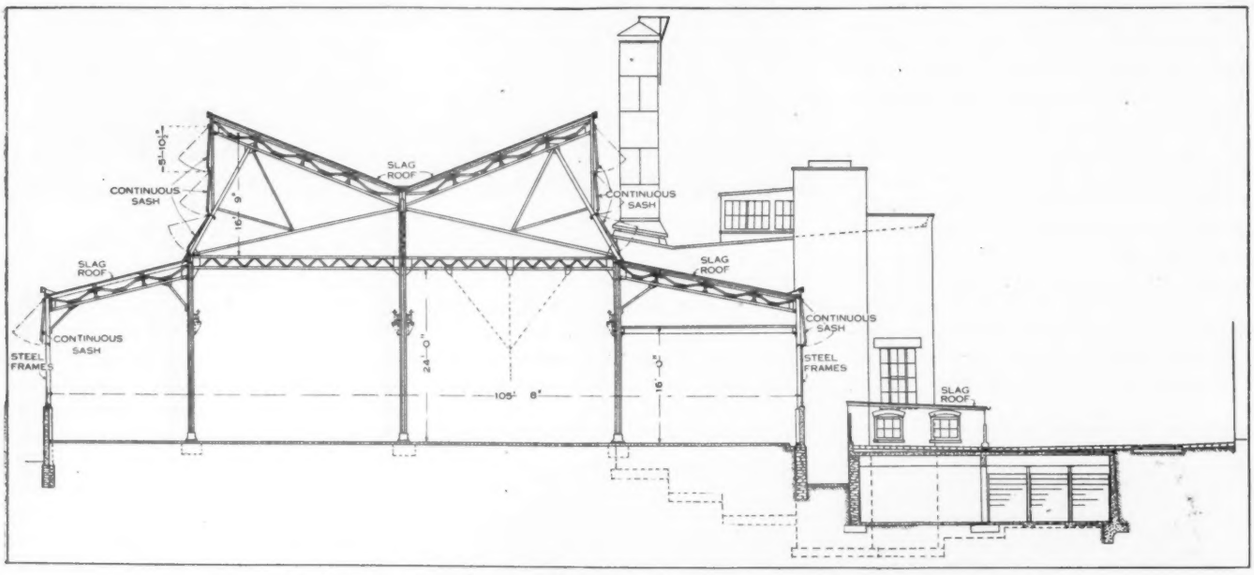


FIG. 22—CROSS-SECTION OF FOUNDRY BUILDING, SHOWING ROOF CONSTRUCTION

ing machine, one rod-threading machine, one nut-tapping machine, one grindstone and one multiple pipe-drilling and tapping machine. Another 7½-horsepower motor operates a drill press, drilling lathe, two emery wheels, and one machine for cutting catch slots in heater fronts and range fronts and doors. A 10-horsepower motor operates three bench grinders, four large emery wheels, three drilling lathes, three drill presses and one table grinder for grinding cover holes.

For inter-departmental transportation in the finishing building, a transveyor system, built by the Cowan Truck Co., Holyoke, Mass., has been installed. It consists of a truck with removable platforms, which are provided with four legs each. Each platform, while resting upon the floor,

receives its load. The truck then is moved under the platform, lifts it free of the floor and delivers it to the department designated. One of these trucks can handle 150 platforms, being designed to carry a load of 2,500 pounds.

The power plant equipment consists of a 240-horsepower, cross-compound Buckeye engine, direct-connected to a 200-kilowatt alternating current, Crocker-Wheeler generator, belted to a 110-volt, 73-ampere, 60-cycle exciter. Alternating current is used throughout the plant, with the exception of the power for operating the cranes in the foundry. These require direct current, which is supplied by a 200-volt, 25-horsepower dynamo, operated by a 220-volt alternating current motor.

The engine room contains a Bury compressor which, by means of an automatic cut-off, maintains a pressure of from 85 to 100 pounds in a tank located in the underground passage leading from the sand storage vault to the basement of the core shop. Compressed air is used mainly for operating the vibrators on the molders' benches, for cleaning the motors throughout the plant and for operating pneumatic chipping hammers. The boiler house, 20 x 47 feet, adjoins the engine room and is equipped with two boilers of 150 and 200-horsepower capacity, respectively.

The boiler room is equipped with an ash-handling bucket and chain hoist supported by a trolley on an overhead tramrail. The ashes, as well as slag from the cupolas, are used for filling the low levels of the property.

Heating System

The plant is heated by a vacuum system installed by the Warren-Webster Co., Camden, N. J. The exhaust steam from the engine passes through a Cochrane feed water heater, which filters and heats the steam. It is then drawn through the heating system at a pressure of four pounds, condensing finally in a tank in the boiler room. From the tank the water drains back to the feed water heater and from the latter it is fed back to the boilers by a pump. Thus the circulation is continuous, and the only water wasted in the system is a small quantity which flows from the cooling jacket of the air compressor. The steam distributing mains are carried underground.

All the buildings, in addition to being built as nearly fire-proof as possible, are equipped with automatic sprinklers connected to a 30,000-gallon tank on the roof of the finishing building. Two hose stations are located in the yard to command all portions of the plant. A fire pump, with a capacity of 500 gallons per minute supplies the hose stations. The water may be pumped either from tanks on the roof of the main building or from the city mains.

In laying out the plant, the welfare of its employes was a feature to which the Sheppard company devoted special attention. Not only are the buildings designed to insure ample light and adequate ventilation, but each department is provided with its own toilet facilities. The wash-room, which adjoins the power plant, contains 200 steel lockers on the first floor and the same number on the second floor. Every workman employed is assigned a locker. On the first floor the lockers are arranged in two rows along the walls, the 30 wash-basins being located in the center. On the second floor six shower baths have been installed, which are divided off from the lockers by a partition. Above the lockers are racks on which clothes and towels may be hung to dry. In order that the molders may not have to expose themselves to the outside air during cold or rainy weather, the foundry and wash room are connected by a steam-heated, underground passageway.

The firm of Isaac A. Sheppard & Co. is now entering upon the fifty-third year of its existence. The principal owner was Isaac A. Sheppard who, as opportunity offered, purchased the interests of his partners. His two sons, Franklin L. and Howard R., were later admitted to the firm, and now are the sole surviving partners and owners. The Baltimore plant of the company was established in 1867.

Rust-Proof Finish

A new method of obtaining a black, rust-proof finish on iron and steel is the subject of a patent granted to Frank R. G. Richards, Coventry, Eng. The process is carried out as follows: A solution is made of water, 120 gallons; manganese dioxide, 3 pounds, and concentrated phosphoric acid, ½ pound. The solution is heated to the boiling point and the iron and steel articles, previously cleaned, are immersed in it from 30 to 90 minutes, when they are removed, wiped and coated with linseed oil.

The Bury Compressor Co., Erie, Pa., will erect an addition to its plant extending the main building 100 feet. The present capacity of the works is insufficient to meet the demands of the trade for the company's line of compressors.

MELTER'S REPORT

Cupola No. 1 Feb 14 1913

MATERIAL	1st Charge	2d Charge	3d Charge	4th Charge	5th Charge	6th Charge	7th Charge	8th Charge	9th Charge	10th Charge	11th Charge	12th Charge	Total, in Pounds
Coke, lbs.,	1600	700	450	450	450	425	425	425	425	425			5775
Coal, lbs.,	800												800
Total Fuel,	2400												6575
Pig Iron, Lbs., No. 1,													
No. 2, Donaghmore	900	800	800	800	700	700	600	600	600	600			7100
No. 2, Dunmore	800	700	800	800	700	700	600	600	600	600			6900
No. 2, Pilaske	800	700	700	700	700	700	500	500	500	500			6300
Silicon,													
Total Pig Iron,	2500	2200	2300	2300	2100	2100	1700	1700	1700	1700			20300
Gates & New Scrap,	1500	1000	1000	1000	1000	1000							6500
Cupola Scrap,													
Bought Scrap,	800	1000	1000	1000	1200	1200	2200	2200	2200	2200	1200		16,200
Total Scrap Iron,	2300	2000	2000	2000	2200	2200	2200	2200	2200	2200	1200		22,700
Total Iron,	4800	4200	4300	4300	4300	3900	3900	3900	3900	3900	1200		43,000

Summary, Total Fuel, 6575 lbs. Total Pig and Scrap, 43000 lbs.

Ratio of Fuel to Iron melted ____ to ____ Quality of Melted Iron, Not all through heat

Cupola lighted at 12.30 P. M. Test Bar broke at 470 to 500 lbs.

Blast put on at 2.30 P. M. Deflection .17

Heat over at 4.25 P. M. Foreman

FIG. 23—MELTER'S REPORT OF CUPOLA CHARGES

How to Select and Care for Pattern Lumber

The Adaptability of the Various Woods for Model-Making Are Discussed and the Value of Northern White Pine is Pointed Out

By E F Lake

FOR making patterns, many different kinds of woods are used, although in the United States and Canada, northern white pine and mahogany are most extensively employed for making models for the casting shop. For small, intricate patterns, particularly designed for repetition work, mahogany is recommended, but for general utility, northern white pine is the ranking pattern lumber. Other woods, such as cherry, walnut, cedar, redwood, whitewood, maple, birch, spruce and even hemlock can be used to advantage for pattern-making under certain conditions.

How Growth Affects Quality

The woods that grow on high, dry ground are more suitable for patterns than those which grow on low, wet land, or in swampy places. The latter are known as water-woods and the conditions under which they grow make them absorb moisture much more easily than the so-called dry woods. Myriads of miniature channels are formed in the water-woods, causing a rapid growth of the trees, and as a result the grain of these woods is not so fine and dense as that of lumber grown on dry land. The water-woods are of a spongy nature and when patterns made from such woods are embedded in damp sand for molding operations they absorb more moisture than the so-called dry woods. This causes the wood to swell and expand and has a tendency to warp and distort the pattern, making the casting larger than the specified size. Patterns made from other than the water-woods, occasionally will swell when left in a mold over night. In one instance the time required to mold a large engine bed caused the pattern to be subjected to the moisture of the molding sand for two days and nights and it wedged so tightly in the mold that it was broken in the attempt to draw it out of the sand.

There are many kinds of pine and of these the *Pinus palustris, Pinus rigida, Pinus resinosa, Pinus echinata, Pinus ponderosa* and some others are useless for patternmaking. These are commonly called yellow pine, Georgia pine, North Carolina pine, norway pine, loblolly pine, hard pine, bull pine, pitch pine, straw pine, slash pine, old field pine, swamp pine etc. These grades of pine are full of pitch, which oozes out when the pattern is subjected to the heat and moisture of the foundry. This causes the sand to adhere to the pattern, making it difficult to draw and the surface becomes too rough for molding the second casting. These woods also split easily, are hard to work to a smooth surface and difficulty is experienced in driving nails into them.

E. F. Lake

Born in Oswego, N. Y., E. F. Lake received his early education at Syracuse, where he served an apprenticeship at patternmaking in the plant of the Straight-Line Engine Co., operated by Prof. John A. Sweet. During the last year of his apprenticeship he began the study of metallurgy. From 1899 to 1902 Mr. Lake was employed by the General Electric Co. at Schenectady, N. Y., and in 1903 he was affiliated with the Westinghouse Electric & Mfg. Co. at East Pittsburgh. Subsequently he was employed by the Carnegie Steel Co., the Lorain Steel Co. and the Garford Co., manufacturer of automobiles, Elyria, O. In 1907 Mr. Lake was appointed steel editor of the *American Machinist*, resigning in 1911 to engage in metallurgical and consulting engineering work. His office is located at 1453 Waterloo street, Detroit.

The *Pinus strobus, Pinus lambertiana, Pinus monticolo* and *Pinus flexilis,* which are commonly called white pine, soft pine, sugar pine, and pumpkin pine are extensively used for making wood patterns. On large work, where a limited number of castings is required, this is without doubt the best lumber to use. It can be worked easily to a smooth surface, does not split readily, is easier to pare than any of the other woods and does not as quickly dull the paring chisels or other edge tools and saws. It also has a sufficiently fine grain to take a high polish with the shellac varnishes. Even with the comparatively high price of from $65 to $100 per 1,000 feet for the better grades, when the patternmaker's time is taken into account, northern white pine probably is as cheap as any wood that can be used for patterns. It is easily kiln-dried and does not warp, shrink nor check so much as most of the other woods. It is light and durable and when well-seasoned is not subject to the attacks of boring insects. As a rule, the heavier the wood the darker, stronger and harder it is and the more it shrinks and checks. It also warps more than the lighter wood.

Next to the pines rank the spruces, which also are graded in the hard and soft varieties. The hard grades resemble the hard pines and are useless for pattern lumber, but the soft variety closely resembles the soft pines and is less resinous. While it is cheaper than pine and can be used to advantage in some parts of the country where it grows to good size and permits clear lumber to be obtained, it is generally not as free from knots as pine and has a harsher grain. Therefore, there is more waste from this lumber and it dulls the paring chisels and other cutting tools more quickly than northern white pine. It also warps more readily and patterns made from it must be nailed or otherwise secured against distortion. Spruce that grows on the high ground is drier than pine and does not absorb moisture as readily, but that which grows along streams and lakes resembles the water woods too much to be used satisfactorily for pattern work. In the Rocky Mountain states suitable spruce for making patterns can be obtained, but in the east, if the waste and increased time of working are considered, it is more expensive than northern white pine even though its price per 1,000 feet be considerably less.

Poplar

Poplar or white-wood, as it is variously termed, is frequently used for making patterns. It has a fine texture with a satin luster, is straight-grained, soft, shrinks moderately, splits on the ends and checks but little, and hence seasons well without injury. Some grades warp more readily than pine, but it is a dry wood that does not absorb moisture easily. It can be given a fine finish with shellac and this aids in repelling moisture. It is gritty and quickly dulls edge tools such as paring and carving chisels, planes, etc. These undesirable properties and its excessive

warpage are sufficient reasons for its comparatively limited use. More time is required to build patterns from poplar than from northern white pine, but if wood from the tulip tree, *Liriodendron tulipifera,* is used, the patterns are more durable than when made from pine. Basswood is of a similar nature, but is never used on account of its high shrinkage and tendency to become distorted.

Hemlock is soft, brittle, knotty, cross-grained, rough and splinters easily. It also shrinks and distorts quickly, and splits readily. Thus one would assume that it is absolutely useless for pattern lumber. Its price, however, is so much lower than that of pine, that a considerable saving can be effected by building the framework of large patterns with hemlock and then covering it with pine or other fine grained woods for the finished surfaces. Only for the largest patterns can it be used successfully, as the difference in price that would be saved on the few feet employed in a medium size pattern would not compensate for the extra cost entailed by storing a separate stock of hemlock and working it to the proper shape.

Redwood

Redwood, *Sequoia sempervirens,* white cedar of the west, *Chamaecyparis lawsoniana,* and the canoe cedar, *Thuya, gigantea,* are all different species, but their lumbers are so similar that they can be considered as one variety. These woods are obtained from giant trees found in California, Oregon and Washington, and furnish a large part of the lumber used in the western states, sometimes being employed for patterns in that section of the country. They are soft and are used for purposes similar to that for which pine is adapted. Their grain is coarser than that of pine, but not nearly so coarse as that of hemlock. They split more readily than pine, but grow reasonably free from knots, and being softer than pine, can be dented more easily. Pressing the finger nail along the smooth surface will leave a mark that can be plainly seen, but it takes a smooth polish from the shellac varnishes applied by patternmakers. The red cedar of the eastern states and the middle west is a smaller tree than that of the western coast and its wood has a finer grain. It can be filled and varnished in such a way that it will resemble some of the mahoganies. A pattern made from this red cedar would have a fine appearance, but as the wood is soft, it would not be as durable as a pattern made from pine. The cost of red cedar is greater than that of pine, and hence it is seldom, if ever, used for patterns. The white cedars are of the water wood type, and, being as soft as the red cedars, they are not at all suitable for patterns. None of the cedars can be pared as easily as northern white pine and edge tools are dulled much more quickly, owing to the harshness of the wood.

Cypress

Cypress, *Taxodium distichum,* is one of the cheaper woods that have occasionally been used for patterns to reduce their cost of manufacture. The different varieties of this wood include white, black, red and bald cypress. The black and white are the heavy and light grades of the same species. It is similar to white cedar and can be given a good polish with shellac. However, cypress is one of the soft water woods and patterns made from it are not durable, although shellac, for a short time, will overcome its tendency to absorb moisture. If only one casting is required a saving can be effected on large patterns by the use of cypress, as its price usually is between $40 and $55 per thousand feet, as compared with $90 to $110 for pine suitable for patterns. If such a pattern is not left in the sand too long, two or three castings may be obtained before the wood has swelled and warped sufficiently to distort and alter the size or shape of the casting. When as many as five castings are required, the extra time consumed by the patternmakers in working this wood to shape and nailing or screwing it to secure the pattern against distortion, would absorb the difference in cost between cypress and northern white pine and under ordinary conditions, therefore, the latter is the cheaper lumber to use. No wood can be worked to shape, nailed and screwed, as easily as northern white pine, nor will the cheaper woods stand up for nearly as many castings. Thus, where cypress would only last for two or three castings, a pine pattern, built in the same length of time, would ordinarily mold ten castings before it requires overhauling. When a large number of castings is to be made from the same pattern, the hard woods are so much more durable than pine that there is no comparison between the two. Even with the cost of the lumber doubled and the time consumed by the patternmaker increased from 25 to 50 per cent, the cost of the pattern is less per casting made than when softer woods are employed.

Of the hardwoods, the mahoganies, which have to be imported, have been found to be so easily workable into patterns, so impervious to the moisture of the sand, and so fine-grained, readily taking a high finish with shellac, that they have been adopted as the standard wood for fine patterns that have to be used for a large number of castings. The West Indies, Central America and Mexico are the principal sources of supply, although considerable mahogany is imported from Africa. Honduras mahogany, sometimes called bay-wood, has the straightest grain, as it is cut from large trees that often yield logs 40 feet long. Therefore, this is the best grade of mahogany for patternmaking. Mexican mahogany attains the largest growth, but it is not quite as straight-grained as bay-wood and ranks second in its adaptability to pattern work. There are various grades of African mahogany, ranging from very hard, dark-colored, wavy and figure-grained woods, which give beautiful effects in furniture, but are too difficult to work to smooth surfaces for pattern work, to the softer, lighter-colored, straight-grained lumber that is well adapted to pattern work. African mahogany, therefore, should be examined before it is purchased, and this is a good rule to follow when buying any pattern lumber. Most of the San Domingo and Cuban woods, which are commonly called Spanish mahogany, have a wavy and figured grain, that lowers their value for pattern work. There are many other kinds of mahogany which grow in various parts of the world, but those noted are the grades most easily obtained in American markets. The coffee tree of Kentucky has been termed Kentucky mahogany, owing to its close resemblance to this wood.

Properties of Mahogany

The mahoganies, as a rule, are sound and uniform in structure and have only a slight tendency to warp and shrink. Yet I have seen the top pieces of a pile of mahogany curl up sufficiently to be a foot out of flat in a length of 12 feet, when left standing only four weeks in a warm room. I also have seen mahogany planks split nearly to the center from both ends. The quality of this lumber varies greatly with the condition of its growth. In exposed places and on dry and high ground, the trees will yield a wood that has a fine, dense and straight grain, while in low, soft land, it will be of the curly, coarse-grained kind that is not desirable for patterns. To compare the durability of mahogany and pine patterns, an experience with a pine automobile engine crank case pattern will

be cited. The pine pattern was made as durable as possible and after 63 molds were produced, it was returned to the pattern shop in a badly broken condition. After the pattern was repaired, 65 molds were made, when it was again returned to the pattern shop in such a dilapidated condition that it was decided to replace it with a mahogany pattern. Before the latter was returned to the pattern shop for attention, 135 molds were made. The pattern was only slightly worn, and after alterations recommended by the engineers were made, the mahogany model had a run of 238 molds before it was returned to the pattern shop to be overhauled. In about one-third the time required to make a new pattern, it was overhauled and repaired and was returned to the foundry for further use.

Cherry for Patterns

Cherry, *Prunus serotina,* has a finer texture, is stronger and harder than mahogany.

It has a straighter grain than most of the mahoganies, takes as fine a polish, is more durable, and does not split on the ends nor check so readily, although it shrinks considerably in drying. Cherry warps only slightly, and even though it is somewhat harder to work, it excels mahogany in so many other ways that it can be called the very best wood from which to make fine, durable patterns. Its cost is less than that of mahogany, grades of which suitable for patterns are quoted at from $55 to $150. Mahogany is more gritty than cherry and dulls saws more quickly, particularly when operated at the high speeds of the machines in the pattern shop. Cherry, on the other hand, is more difficult to pare and carve than mahogany. On the average, it requires from 5 to 10 per cent more labor to build small patterns, such as automobile engine cylinders, from cherry than from mahogany, but this is compensated for by the difference in the cost of the lumber. While the pattern cost would be nearly equalized, a larger number of castings could be made from the cherry pattern than from the mahogany model, and the cost per casting would be less.

Of the other hard woods, maple, birch and beech are too hard to work into patterns successfully. It is nearly as easy to make a metal pattern as to make one from hard maple and the others are but little softer. These hard woods, however, are well adapted for lining the tops of core boxes. In striking-off cores, the sand wears away the tops of soft wood boxes long before any other part has become worn, and as a result the cores are reduced in size. A strip of hard wood around the top of a core box will greatly prolong its usefulness by protecting the edge where the sand is struck-off. Sometimes, also it is advisable to make bosses and loose pieces from these hard woods so they will not wear out before the rest of the box.

Black walnut formerly was considered excellent material for patterns, but it has become so scarce that it no longer is ranked as a pattern lumber. The coarse grain, porous woods, such as oak, elm, butternut, etc., are not adapted to pattern shop use.

Properly seasoned lumber is as essential to the satisfactory production of patterns as its selection for other work for which it is required. If wet lumber is placed in an atmosphere that is too hot and dry, it will season too quickly and will crack at the ends or will be filled with checks. If, for example, 100 pounds of water are associated with 100 pounds of dry wood substance, about 5 pounds of water are contained in living cells; 35 pounds are required to saturate the wood cells and 60 pounds are held in the cavities of the wood fibers. To remove all of the water would destroy all life and decomposition would be the result. Therefore, lumber that is properly seasoned contains a considerable percentage of water. Different woods contain varying quantities of water, and the time required to expel this moisture differs widely. The rapidity of drying-out depends upon the size and shape of the lumber. A plank 1 inch thick will dry six times as fast as one 4 inches thick and 20 times as fast as a plank 10 inches thick. Therefore, it is not good practice to place different kinds of wood in one dry kiln nor of different thicknesses of the same kind of lumber.

Carload Purchases Recommended

When lumber is removed from the dry kiln in damp weather it again absorbs moisture. In a period of only one week a 1-inch pine board may regain two-thirds of the moisture that was expelled in the kiln, and in a few months a large percentage of that which was expelled by air drying Pattern lumber, therefore, should be used directly from the kiln. For this reason much better results are obtained where pattern lumber is purchased in carload lots and dried in kilns before use. Lumber kilns are not expensive to build and can be operated economically with waste steam. It also is advisable to purchase rough lumber which can be planed to the desired thickness while it is being cut to size for the pattern. While small pattern shops may not have the facilities for drying their lumber in kilns, nor sufficient storage capacity for carload lots, it nearly always is possible to obtain properly seasoned lumber from the larger shops that buy well selected material in large quantities.

If dry kilns cannot be installed, well-seasoned lumber should be bought in carload lots and stored overhead or in a well-heated closed room. When stored in piles the boards should not lie flat on top of each other, but 1-inch square strips should be laid between them to facilitate the circulation of air around all sides of the boards. Pattern lumber also can be stored on edge in a rack. This reduces warping and enables the patternmaker to pull out any board without being compelled to overhaul the entire pile of lumber. Boards should never be set on end as this causes them to dry out more at the top than at the bottom and increases their tendency to split and warp.

New England Foundrymen's Program

An interesting program for the 1913-1914 season has been outlined by the New England Foundrymen's Association, which will include papers on the following subjects: "Grinding Conditions in the Foundry", by Carl F. Dietz, of the Norton Co., Worcester, Mass., Oct. 8; "Savings Bank Life Insurance", by H. W. Kimball, secretary Massachusetts Savings Insurance League, Nov. 12; "Co-operation Among Foundries", by Dr. Richard Moldenke, Dec. 10; annual meeting, Jan. 14, 1914; "Sand Blast Equipment and Foundry Appliances", by A. G. Warren, J. W. Paxson Co., Philadelphia, Feb. 11; "Accurate Cost Control for the Foundry", by E. W. Riger, March 11; "Auto Trucks", by Day Baker, of the General Vehicle Co., April 8. No subject has been announced for the meeting to be held May 13 and the annual smoker will be held on June 10.

The Jonathan Bartley Crucible Co., Trenton, N. J., has built a one-story addition to its plant to provide additional manufacturing facilities to meet the increased demand for its graphite products.

F. Felkel & Sons, architects and engineers, Pittsburgh, have opened an office at 404 Marshall building, Cleveland.

The Electro-Galvanizing Process

By Seymour W Rowsbar

ELECTRO-GALVANIZING, or electro-zincing, as the process frequently is termed, is recognized as one of the most valuable of plating methods. Until a recent date, the utilization of zinc as a protective coating for iron was facilitated only by the hot or molten process. Yet by some unexplained means the term *galvanized iron* was applied to the product. As the process consisted merely of immersing the iron in the molten zinc, whereby a film of zinc became attached to the iron, the method was in no manner electrical and, therefore, no galvanic action took place. A possible explanation of the origin of the term with reference to the molten method might be attributed to the fact that while in moist air zinc becomes covered with carbonate and oxides and is thus protected from further chemical changes.

Protective Coating for Iron

Zinc prevents oxidation of iron when used as a protective coating by reason of its higher electrical potential. Metallic zinc, when fused and pure, has a specific gravity of 6.91, and it can be rolled into sheets when hot, although at ordinary temperatures it appears quite brittle. That the Romans were familiar with the art of manufacturing zinc-copper alloys is proven by the analyses of some of their coins struck soon after the commencement of the Christian era. Yet zinc itself was not known in Europe as a distinct metal until Paracelsus described its distinctive properties in the 16th century. Zinc, however, was brought from the east by the Portuguese long before it became an article of commerce in Europe, and is supposed to have been known and made into articles of use and ornament both in India and China from an early period. Since the original commercial production, which began about 1743 in Bristol, the manufacture of zinc has rapidly acquired great importance, and in 1910 the world's supply totaled nearly 1,000,000 tons.

First Patent for Galvanizing

The first English patent for galvanized iron was granted in 1837, and the operation as performed then in a bath of molten zinc has remained practically unchanged to the present day. Therefore, the electro-deposition of zinc on a commercial scale has met with the usual prejudice attending any innovation into the electro-plating field. While the progress was slow for several years, the electrical system is now coming to the front prominently and is being employed for the better classes of work. A brief review of the many requirements for non-corrosive coatings of the nature of zinc will suffice to awaken any investigator to a fuller realization of the importance of galvanizing in the industrial and domestic world.

With a solution properly proportioned a very adherent deposit of extra durable thickness may be obtained and the thickness may be regulated by the time allowed for deposition. The surface of electro-deposited zinc is smoother than that from a molten bath, and owing to the fact that nearly all electro-deposits are of greater purity than those obtained by immersion of metals in molten baths, the possibility of the disintegration of the coating when in contact with dilute acids, bases or ordinary atmospheric moisture is greatly lessened.

Probably the most recent process for electro-galvanizing is one for which Mr. Cowper-Coles, the veteran English experimenter, has filed a claim for a patent. It consists of cleaning and heavily plating the metallic surface with pure iron before it is covered with zinc or a zinc-iron alloy. It is also possible by this process to obtain the two coatings from one electrolyte which would contain approximately 20 ounces each of the crystalline sulphate of iron and zinc per gallon, by utilizing a low current density at first, followed by a higher current density to obtain the zinc. Small iron anodes are employed together with insoluble anodes and the electrolyte is circulated over zinc scrap. Heating after deposition is said to improve the deposit and increase the adhesion.

Another interesting process, originating in France and accredited to Lemetre, consists of the use of a solution composed of commercial crystallized sulphate of zinc, 25 pounds; ammonium chloride, 6 pounds; commercial crystallized sulphate of soda, 4 pounds; water, 25 gallons, and commercial sulphuric acid at 66 degrees Baume, 1½ pints. The bath is used cold and a galvanic deposit is obtained by employing an electric current of from 2 to 4 volts tension, according to the strength of the bath. Anodes of pure zinc are required to obtain the best results.

Freak Solution

Baths of different compositions may be employed if capable of a combination or disassociation in the midst of the liquid constituting the bath which will form ammonium chloride, sulphuric acid and the sulphates of soda and zinc. Such baths as the two just described are often termed freak solutions, and while there may be a possibility of success attending their use, this class of electrolytes seldom produce a popular and reliable bath for any purpose. The most

successful and desirable baths in general use are the simple ones. The operator quickly learns to manage them and the deposits seldom fail to reach the standard expected by the consumer. With reference to the average plants in which the electrical process is installed, the cost of operation is reduced fully 50 per cent, which is in itself a great advantage, and also a uniform coating is applied and the articles thus treated will bear bending and stamping without cracking the deposit.

The most important objection to the molten process is that tempered and hardened steel cannot be treated as the temperature of the baths is sufficient to remove the temper. This disadvantage is easily overcome by the electrical method, and any article tempered or hardened which may be plated in other metallic baths, receives a coating of zinc without injury. Furthermore, the coating by the old process is particularly irregular on pieces with projections. The coatings are often quite porous, thus affording reduced resistance to corrosion, and this feature, coupled with the impure quality of the zinc employed, causes failure by reason of atmospheric influences. The adherent qualities of the coatings by the hot method have been subjected to comparative tests and found to withstand but little more than one-half the strain which an electro-deposit resisted, while the latter proved greatly superior when tested for strength and firmness.

Economy in Zinc Consumption

Probably one of the most important points in favor of the electrical process is its economy in the consumption of zinc. Zinc coatings on iron for protective purposes are usually tested in a concentrated solution of copper sulphate at about 24 degrees Cent., the solution having a specific gravity of 1.186. The test varies from one to five one-minute immersions, then the test piece is quickly washed and wiped dry. The average coating usually requires not more than two immersions. The amount of zinc necessary to protect iron from mild corrosive influences must endure a one-minute immersion in the above mentioned solution and varies in quantity according to the class of work treated, from 0.25 ounces per square foot to 0.5 ounces per square foot by the molten process compared with 0.15 ounces per square foot by the electrical method, the resistance to corrosion being equal. Here again the purity of material is evidently responsible, as no doubt corrosion is greatly retarded by the absence of local action occasioned by impurities which characterize the old style coatings. For certain purposes where a degree of accuracy is essential the electrolytic method is demanded by large contractors as the various parts are more easily assembled and the appearance of the finished machine is noticeably improved.

Coating Threaded Parts

The electric process does not interfere with the size of threaded parts, thereby avoiding the expense of re-threading. In every case where comparative tests have been made the electro or cold process has been found least expensive in the items of labor and material. The output for a given capacity of baths has been increased and the time required greatly reduced. In view of the fact that the electro-deposit may be given some articles which cannot be treated in the molten bath, some firms find an advantage in operating both methods, and in England the cold process is employed in combination with the hot method, the by-products of dross from the hot baths being utilized in the electrical treatment, thus permitting efficient results at a low cost.

A small amount of iron is dissolved from all the articles treated by the hot method, and a dross frequently amounting to 33 per cent of the total quantity of zinc used is formed. By analysis this alloy gives up from 3½ to 6 per cent of iron.

The cold process does not attack the iron, there is no dross formed, no expense or annoyance from heating a great mass of metal and the coating is uniform. Both the preparatory pickling in strong acids and the hot zincing diminish the strength, render brittle and warp iron or steel wire of small diameter. Zinc fuses at 775 degrees Fahr. and vaporizes at 830 degrees Fahr. Therefore, the use of sal-ammoniac to cover the molten metal is necessary to prevent volatilization and acts as a flux to unite the zinc and iron.

Steel wire of high breaking strain has its hardness, and naturally its tensile strength and elongational efficiency reduced by as much as from 4 to 8 per cent by drawing the temper and the formation of an iron-zinc alloy on the surface of the wire. It has been the practice to keep the bath at as low a temperature as possible, and to run the wire at a high rate of speed through the bath. Both these operations encourage a waste of zinc on account of the rapid solidification of the metal on the comparatively cold wire and, consequently, the easy breaking or cracking of the coating when twisting or bending it, owing to the difficulty with which the zinc adheres to the steel except after a long immersion in the bath. Even if passed through asbestos wipers or rubbers, the coating resists corrosion but briefly. These difficulties are entirely overcome by the modern electro-deposit. Cables, which a few years ago were considered impossible to treat in an electrolyte, are now treated as readily as a half-inch water pipe.

Experience and observation causes us to believe that the usual cause of zinc solutions failing is an impoverished or weak condition of the bath. In such cases great improvement will be noted if 2 pounds of crystallized sulphate of zinc and 2 ounces of sal-ammoniac are dissolved and added to the bath for each gallon of solution. This is especially effective when working on sheet steel stampings having depressions and has given excellent results. If the electrical process possesses a disadvantage, it is that a solution which will deposit splendidly upon articles of uniform shape, does not always produce a satisfactory coating at the bottom of depressions. In plants where these conditions are constantly being encountered, it is advisable to pay particular attention to the metallic strength of the solution. Some galvanizers claim to obtain the best results in such cases with a solution of only one-half the density of the normal solution, operating the bath with the same voltage as with denser solutions.

Cyanide Zinc Bath

A more effective and reliable proceedure when treating work with deeply depressed portions is to employ a cyanide zinc bath which is as superior to the sulphate bath in throwing qualities as the cyanide copper bath is to the acid copper bath. The cost of the bath is its greatest fault, but when used simply as an auxiliary bath, its cost is not important. The solution is most effective at a temperature of 120 to 150 degrees Fahr., which also allows a lower voltage to be used and the depressions receive the deposits more rapidly and in better condition.

Such cyanide zinc solutions are composed of potassium or sodium cyanide, 1 pound to each gallon of water. This cyanide solution is then saturated with carbonate of zinc, using the plastic form, as it is easily dissolved. It is advisable to avoid an excess of carbonate, but an addition

of about 6 ounces of cyanide solution to each gallon will take up a slight surplus and will leave ample free cyanide. Free cyanide is really essential to insure proper conditions in the bath. Operate the solution with from three to five volts when used cold, while 1¾ to 2½ volts will suffice with hot solutions. While it is exceedingly doubtful that electro-galvanizing will ever be perfected to such a state as to produce coatings which will be superior in every detail to the hot method which has stood the test of time, it is an acknowledged fact that every year the number of plants electrically-equipped for the purpose will increase, because the tendency of the manufacturer to reduce operating expenses is too frequently given first consideration and the adaptability of methods employed is merely of secondary significance. Such conditions are to a great extent the cause of much of the inferior metal coatings seen on various products today, and the public's gullibility in this direction is being determinedly taken advantage of.

Modern Electro-Galvanizing Plant

The electro-galvanizing process is, however, an advance in many respects and great credit is due the various experimenters for the wonderful developments of the past few years. As an illustration of what is being accomplished in this direction, we have only to inspect a modern electro-galvanizing plant, one of which has recently been installed by the Canadian Hanson & Van Winkle Co. for the Orpen Conduit Co., Toronto, Can. This plant has several unique features, as it is the largest electro-galvanizing works in Canada and has a capacity of 50,000 lineal feet of conduit per day. It is also interesting to note that the plant is practically automatic, the work being loaded on large steel cages and is carried from the loading station to and through the various solutions and rinsing waters by means of an electric trolley, thus avoiding any manual labor other than the operation of the electrical control. The work is not touched by hands until dried. In the course of preparation the work is cleansed in a solution of hot *Kostico*, which is superior to caustic potash and retains its strength for a longer period; then it is rinsed and immersed in a solution of *Pickilene*, which has a very rapid action upon scale, rust and sand and has no injurious fumes, such as characterize acid pickling solutions.

When pickled sufficiently, the work passes to a rinsing tank and then is given a coating of copper in a warm cyanide bath with a density of 12 degrees Baume and at a pressure of five volts. This copper coating renders the subsequent zinc coating more effective and is obtained in a comparatively short time. Following the copper deposit, the work is rinsed and then receives a beautiful coating of zinc. When dried the interior portion is automatically coated with enamel and the zinc deposit is subjected to the "Preece" test. The dynamo used is of special interest. It has a capacity of 8,000 amperes at five volts as an ordinary multipolar machine, but being of the interpolar type, the capacity is virtually increased to 9,000 amperes, as demonstrated by actual test. These interpoles take care of any overload up to 1,000 amperes above the rated capacity of the machine. The machine also is equipped with a patent armature sliding device which is attached to the end of a bearing and causes the armature shaft to move endwise in a manner which prevents grooving the commutator surface by continually changing the lateral contact point of the brushes. This machine, we believe, is the largest plating generator in the Dominion of Canada.

The automatic pipe galvanizing section comprises seven tanks, all of cylindrical form, and each of 4,000 gallons capacity; they are 12 feet in depth, the top projecting above the floor at a suitable height for operating. The elbows, nipples and all small parts for any size conduit up to 6 inches are galvanized in a smaller bath and a *jumbo* mechanical plating apparatus having a capacity of 1,000 pounds per hour. The plant covers a floor space of about 7,500 square feet and has a capacity in straight pipe of over 15,000,000 feet per year.

Processes Compared

It is indeed remarkable, in consideration of the many known advantages of the electro-deposition of zinc, that the process has only recently been received with favor. The deposition of zinc is simpler than other metals commonly used for protective purposes and the manipulation of the electric solution far more pleasant than the hot bath, while for cheapness it cannot be equalled by any method or metal. Both the hot and cold processes have their peculiar advantages and produce a coating which is the best protection known for iron or steel. This is due not only to the mere covering of metal, but to the electrical relation between zinc and iron. Zinc being electro-positive to iron, if the metals in contact are subjected to corrosive influences, such as moist air, the zinc is attacked in preference to the iron, owing to the galvanic action generated. Copper-covered iron would reverse these conditions. Copper being electro-negative to iron, the iron would be attacked instead of the copper.

The essential qualities of modern electro-galvanizing solutions vary but slightly. Certain additions are made in order to produce bright deposits or to increase the conductivity of the solution. These are all more or less well known, and although the application of some good ideas have been patented, very few platers hesitate to try out the idea and if satisfactory, it may be modified a trifle and used. It is difficult to confine the use of an electro-plating solution or chemical compound to certain limits by patents as has been experienced by several firms. With simplicity as our watchword, we will adhere to the plain solution and by the aid of 2½ pounds of zinc sulphate dissolved in 1 gallon of good, soft water and the addition of 1 ounce of sulphate of aluminum with thorough stirring, we will have an electro-galvanizing bath such as is employed universally for a great variety of work.

Operating the Bath

In order to free the bath of any trace of free acid, it is customary to equip the solution with a plentiful supply of good zinc anodes and to allow it to remain idle for 12 to 24 hours.

Maintain the temperature as uniformly as possible, and always above 65 degrees. Test the solution occasionally and if found deficient in salts, add more sulphate of zinc. If the deposit produced is dark, add more aluminum sulphate in the proportions mentioned. The bath should register 20 degrees Baume if pure chemicals are used. Sodium alum is often used in place of sulphate of aluminum and a little acid is generally employed and gives good results. The solution will have an unsettled, milky appearance, but as this is the normal condition of the solution, it need cause no apprehension. If the solution becomes clear, it denotes free acid and the deposit is inferior. The sulphate of zinc is made by dissolving metallic zinc in dilute sulphuric acid and as all metallic zinc contains a small percentage of iron, the iron also is dissolved in this acid. This accounts for the presence of iron in the commercial sulphate of zinc. A tension of five or six volts is required to obtain the best results with as great an ampere flow as possible without affecting the

coherent properties of the deposit detrimentally. This amount varies from 10 to 70 amperes depending on the condition of the equipment, solution and class of work.

The preparations necessary for work to receive an electro-zinc deposit do not differ from those used in ordinary plating processes, unless it be that where hydrofluoric acid is used as a pickle for castings, the acid must be thoroughly removed from the pores of the metal or black spots will remain on the surface of the work after zincing. Boiling in caustic potash usually removes the acid effectively. Nitric acid also is employed for this purpose, but it is productive of unnecessary risks from rapid oxidation. The anode surface must be large and must be kept clean, or otherwise the bath soon becomes depleted of metal and is rendered acid.

Another excellent formula consists of sulphate of zinc, 2 pounds; sulphate of aluminum, 2 ounces; glycerine, ¼ ounce, and water, 1 gallon, which is used with pure zinc anodes. A solution of the following composition produces coherent, dense deposits, which are adherent and smooth, even though less than ordinary precautions are employed in cleaning the articles treated: Chloride of zinc, 8 ounces; chloride of ammonia, 5 ounces; hydrochloride acid, ½ ounce; glycerine, ¼ ounce, and water, 1 gallon. This is used with a zinc anode at a tension of four to six volts and the work is kept agitated in any convenient manner.

A process recently perfected employs a salt or salts of zinc dissolved in an aqueous solution of sodium glycero-borobenzoate in the proportion of two-thirds metallic salts to one-third sodium glycero-borobenzoate and is pronounced particularly suitable for deposits upon iron or steel: The sodium glycero-borobenzoate is made by mixing equal parts by weight of sodium boroglycerid and sodium borobenzoate which may be obtained from any chemical supply house. Sodium biborate is used as a flux or reducing agent in certain soldering operations and when employed in an electrolyte it is claimed will dissolve any oxide present on the work. Therefore, the solution prepared by the originator of the process removes all scale or oxides from the surface of the cathode concurrently with the deposition of the zinc.

Depositing Nickel or Zinc

When it is desirable to deposit nickel over a zinc coating, it has been found advisable to deposit a layer of copper prior to nickeling in order to prevent the action set up by the nickel and zinc in contact, but for various purposes this is not essential and the nickel is deposited directly upon the zinc in a solution prepared from chlorides, such as nickel chloride and ammonium chloride, as the sulphate nickel solution attacks the zinc and causes a brownish black discoloration.

Electro-depositing zinc solutions sometimes cause trouble by producing coatings of uneven color or obstinately refusing, they deposit a white, lustrous coating. Usually, the cause is poor conductivity and may be remedied by the addition of 2 or 3 ounces of sodium chloride, together with about 4 ounces of chloride of zinc to each gallon of solution. These additions are made to the ordinary sulphate solution and result in the production of good coatings of uniform whiteness. Various additions such as *Dextrose* and common black molasses may be employed in place of glycerine, glue, etc. One formula which we believe is covered by patent relates to the use of yeast in conjunction with the *Dextrose*. The yeast apparently prolongs the beneficial effects of the vegetable sugar. Four ounces of *Dextrose* and ½ ounce of yeast are the quantities employed. In conclusion, we wish to advise the progressive plater to include the electro-deposition of zinc on iron or steel in his list of accomplishments. The demand for zinc coatings is gradually, but surely increasing and being simple, the average plater may easily master every detail of the process.

DIFFICULTIES OF THE PLATER

The Reason Why and the Remedy

Cobalt Depositing Bath

I would like a formula for a cobalt depositing bath, also any information relative to the deposition of this metal while operating the solution.

The deposition of cobalt is still largely in the experimental stage and has not been put to extensive commercial uses probably because of the high price of the metal. However, its future is assured, as the known advantages of cobalt as a protective coating is an inducement to progressive men to promote further investigation. The Canadian government at present is greatly interested in the subject, in fact to such an extent that it is carrying on various experiments to promote an increased demand for the metal. If the demand is created, the metal will become obtainable at a much lower figure than at present. While less abundant than nickel, it is extracted from the ore in the same manner and is often found combined with it. Cobalt is separated from nickel solutions by treating with potassium nitrite which precipitates the cobalt only. The pure metal is lustrous with a reddish reflex and has a specific gravity of 8.5. It dissolves slowly in hydrochloric or sulphuric acids, but very readily in nitric acid, forming cobalt nitrate. Its present price is prohibitive for industrial purposes. Ionized cobaltous salts are red, but when ionized they are blue. When cobalt is dissolved in hydrochloric acid, crystals of $CoCl_2 + 6H_2O$ of a bright red color separate from the solution. On heating, these crystals lose water and become blue. A solution of cobaltous chloride is red because it is highly ionized, but the ionization is diminished by the additon of hydrochloric acid and the solution becomes blue. This point should be remembered as it is well known that a highly ionized solution conducts the electric current more readily than otherwise. The only salts you will require to interest yourself in are the sulphate and chloride. Cobalt sulphate, $CoSO_4$, is analogous to nickel sulphate and has the property of forming double compounds with the alkaline sulphides such as K_2SO_4, and this compound, associated with a small amount of ammonium sulphate, may be used for the electro-deposition of cobalt. The sulphate crystals are dark red, while the chloride

crystals as obtained commercially, are pink. A simple and effective bath consists of double sulphate of potassium and cobalt, 1 pound; hyposulphite of soda, ¾ ounce, and water, 1 gallon. It is used with either cast or rolled anodes of cobalt of best quality which should be annealed and sand-blasted before using. The current density is important and must not be too high, from 1¼ to 1½ amperes per square foot being sufficient for adhesive, lustrous deposits of good color, and a tension of 1¾ volts. Thompson's cobalt solution consists of double sulphate of cobalt and ammonium, 1 pound; magnesium sulphate, ½ pound; ammonium sulphate, ½ pound; citric acid, 1 ounce, and water, 1 gallon. It is used warm. This bath is an exceptionally good conductor and is capable of good results. Cobalt deposits are extremely hard and are especially suitable for certain industrial purposes by reason of the resisting properties of this metal when in contact with organic acids.

Pure Copper Anodes

We would like to have some information on the use of pure copper anodes, with particular reference to their conductivity and use.

To thoroughly understand the superiority of an anode of pure copper over an impure anode it is advisable to consider the behavior of each of the elements likely to occur in the impure copper, both at the anode in relation to the solvent employed and at the cathode in regard to its tendency to deposit from copper solutions of different densities and with various volumes of current. With a suitable electrolyte and only a weak current to effect the electrolysis, alloys of all known metals in equal quantities should dissolve, beginning with the most electropositive metal, then the next and so on down the scale until the most electronegative element remains and eventually this will dissolve; or, if these elements were in solution, the order would be reversed and the electronegative element would first deposit.

With the current strength employed in the use of the copper anode, such a reaction is not likely to occur, because the total impurities present are comparatively small, and, taken separately, the proportion is still smaller. There is, however, the tendency to follow in the order mentioned. Practical deposition actually proves that an attack is first made on the surface molecules of the most electropositive metal composing the anode to an extent proportionately greater than on those of copper, but owing to the large volume of current, as compared to the amount of these impurities, the copper also dissolves. By this action a fresh series of molecules is exposed by the removal of the outer layer and these are in turn dissolved, the most positive metals in greater proportions than the copper. This continued action causes corrosion, pitting or cavities due to excessive action locally upon superposed electropositive molecules; then, as the acid penetrates these, the action goes on more and more unevenly into the body of the anode until the latter becomes deeply honeycombed, or is brought to the condition of a sponge if originally it was quite impure. This mass consists chiefly of copper and of metals more electronegative than itself, together with any insoluble oxidized bodies present, the electropositive elements having been largely removed by solution. The detached portion of the sponge falls to the bottom of the tank in the form of slime.

When the proportion of impurities in the copper is not excessive, the anode is less readily penetrated by the solution and the action proceeds more uniformly. A greater percentage of copper dissolves superficially and the spongy deposit on the surface consists almost entirely of the bodies which are not oxidizable in the bath, or whose oxides are insoluble in it. This deposit, being limited in quantity, is not coherent, is more easily liberated and forms a mud exceedingly poor in metal. As copper is an electronegative element, nearly every metal ordinarily found as an impurity in commercial copper anodes tends to oxidize or go into solution before it.

Changes in Color

Nickel, manganese, cobalt, zinc, etc., dissolve and remain in solution and by taking the place of the equivalent of copper which in their absence would have dissolved, cause a gradual depletion of the bath with reference to metal and eventually the continued solution of these small quantities causes an accumulation so great as to render the bath exceedingly difficult to manage. As in a solution, no element should be present in an anode unless it serves some definite purpose. Small quantities of impurities may produce startling changes, as exemplified in the coloring of two samples of copper, one being pure and the other of commercial grade. Whether for acid or cyanide copper baths, the anodes should be of pure copper and of a thickness of from ¼ to ½ inch, and of sizes proportionate to the tank. In acid copper baths, under correct conditions, the anodes will work clean, but in alkaline baths additional agents are sometimes employed for this purpose. Next to silver, pure copper is the best conductor of electricity and is undoubtedly the most efficient grade of copper for use as anodes in electroplating. A small percentage of impurity, such as lead arsenic, etc., also affects the electrical conductivity of the anode. Electrolytic copper anodes are now in general use for copper and brass baths and for electrotyping, pure electrolytic copper anodes are especially desirable; that is, the metal which has been deposited from a pure solution, the second choice being the best rolled copper, as this grade is less liable to contain impurities in such quantities as found in cast copper.

Black Slime

After loosening the black slime from the anodes and previous to its arrival at the bottom of the tank, it remains suspended in solution and is liable to cause trouble by adhering to the cathode. This is especially true if the bath is agitated, the composition of the slime depending on the grade or brand of copper used. The anode surface in electrocoppering baths should present approximately the same surface area as the cathode. Alkaline baths permit of an excess of anode surface, while in an acid bath an anode surface greatly in excess of the cathode surface causes an excess of metal to be liberated if the bath is quite acid, or an insufficient anode surface tends to create an impoverished condition of the solution. Alkaline baths require more constant attention than acid baths on account of the comparative insolubility of the anode.

With pure copper anodes and the electrical conditions normal, the solution of proper metallic strength, etc., the following results should be obtained:

A deposit of 1 pound of copper per hour with 376 amperes of current.

For sulphate baths, use from ½ to 1½ volts and from 14 to 36 amperes per square foot.

For cyanide baths, use from 3 to 5 volts and from 3 to 6 amperes per square foot.

The current density in both cases may be doubled and sometimes trebled if the solution is agitated.

Nickel-Plating Difficulties

We have experienced considerable difficulty with our nickel-plating solution. It contains a deposit of reddish material, and after cleaning the tank and removing the entire deposit, we find a similar accumulation. Samples forwarded contained this red material and some of the material which floats on the surface of the solution.

Your difficulty is not as serious as

you imagine. The reddish substance is merely iron and is derived from both the water and the nickel anode, but the larger amount of it comes from the anode. If you are using a 90-92 per cent nickel anode and will simply note that for every 100 pounds of nickel in the bath in the form of anodes you have 8 to 10 pounds of iron, and that this amount of iron, when in the form of iron oxide, is extremely bulky, especially when moist, it is easy to account for the great accumulation at the bottom of the tank.

Nearly all commercial nickel anodes contain iron in quantities varying from 6 to 15 per cent. Some of this is deposited along with the nickel, while the remainder finds its way to the bottom of the bath or remains in an unsettled condition throughout the solution. If the bath is alkaline, the iron separates out to such an extent that the slightest agitation of the solution causes it to be noticeable throughout the entire bath and as the iron, while in this condition, is of a very light and bulky nature the passage of the electric current induces sufficient agitation in the bath to disturb it and the portion which forms a scum over the surface of the solution is composed of the lightest particles which have been elevated to this position by the escaping hydrogen. When the solution is allowed to remain quiet for a time the particles gather together and then the color is discernible and the fact that a portion floats while the remainder sinks signifies no specific difference in the composition of the substance. A great variety of chemical mixtures may be made to prove this, while frequently minute gas bubbles support the particles.

Making the Determination

To make the determination complete, however, we have analyzed both samples and found them identical with one exception. The sample marked *sinks* contained a much larger percentage of silica or sand, while the sample marked *floats* contained small particles of wood, lint, etc. The analysis of the sample marked *sinks* shows approximately the following composition: Iron oxide, 46.8 per cent; water, 28.3 per cent; nickel, 2 per cent, and dirt, 22.9 per cent.

The iron in this case is undoubtedly derived from the anode, and owing to local action being set up by some otherwise harmless mineral in the water, combined with either an alkaline or neutral condition of the bath, the iron is precipitated as an oxide instead of being deposited with the nickel. Also, as the iron oxide is of a bulky nature, if the bath is rather weak in metal, the iron precipitates out more slowly, and, therefore, is finer and more flocculent.

A nickel solution rich in metal will keep the iron or slime more compact at the bottom of the tank, as the precipitate is of larger form and denser. The iron in a nickel solution maintained slightly acid should not separate out so freely and we believe your bath will show an alkaline reaction. It is not advisable to make too large additions of sulphuric acid for the purpose of avoiding the separation of the iron. Usually the ordinary neutralizing additions suffice to keep the iron in solution. If the iron persists in precipitating out when the bath is sufficiently acid for good work, then we would advise small quantities of citric acid which will keep the iron in solution and will prevent, to a large extent, the rapid formation of slime on the anodes and at the bottom of the tank.

Water for Solutions

There is no practical method of removing the iron from the water for use in the plating room. Rainwater is preferable under all circumstances for nickel solutions and suitable receptacles for a sufficient quantity to meet all demands form a valuable portion of the plating equipment. We are quite certain that in due time your rain-water bath will produce an iron precipitate if maintained in the same condition as the well water bath. To avoid further trouble with the 350-gallon bath made with well water, we advise filtering thoroughly through three or four thicknesses of medium heavy factory cotton tacked over a frame. Then render sufficiently acid with sulphuric acid to turn blue litmus paper a faint red or deep purple. On the day following this addition, try the solution with a batch of work and if the solution is clear when electro-deposition begins, but becomes turbid after working a few hours, the bath requires more metal and should be replenished by the introduction of sulphate of nickel previously dissolved in a portion of the solution by boiling. Then neutralize the excess of acid with carbonate of nickel. The nickel solution should remain quite clear and of good color when sufficient metal is present and slightly acid unless you have previously used sodium chloride in the bath as a conducting salt, in which case the solution might remain turbid, but the iron oxide would not be noticeable and the bath would deposit well. The fact that a deposit formed on the side of tank has no particular significance, but indicates a concentrated solution and the use of considerable current.

The important points to bear in mind are briefly as follows: Maintain sufficient metal in the bath and avoid an alkaline condition which induces the precipitation of the iron. Use nickel anodes with less percentage of iron, or enclose each in a bag made of factory cotton which will retain the greater amount of the slime. The writer has used nickel anodes of various degrees of purity and is of the opinion that iron in an anode for nickeling serves no other useful purpose than that of rendering the product cheaper. We have obtained the best results from the 98 per cent pure nickel anode and strongly recommend them for all ordinary commercial purposes. Since making the analysis of the material submitted as referred to in this reply we have made a further determination in order to ascertain the exact nature of the insoluble portion mentioned as dirt and find it consists of emery, 38 per cent, and sand, 62 per cent. A determination for manganese was also made, but no trace of this mineral was found. Some makers of nickel anodes have of late introduced manganese in addition to iron in the manufacture of so-called high-grade anodes.

Soft Solder

The use of phosphorus in soft solder is specified in a patent recently issued to John T. Dwyer, St. Louis. It is claimed that it causes solder to flow more freely and permits the use of a cheaper mixture. The analysis of the solder follows:

Tin, 41.50 per cent; lead, 56.48 per cent; antimony, 2 per cent, and phosphorus, 0.02 per cent.

In making solder the lead is first melted in an iron kettle to which the tin and next the antimony are added, stirring thoroughly to insure a good mixture. The phosphorus is introduced last by a phosphorizer or other suitable means. While yellow phosphorus may be employed, phosphor-tin is recommended. If phosphor-tin is used the preceding formula should be slightly changed and the following proportions used:

Tin, 41.12 per cent; lead, 56.48 per cent; antimony, 2 per cent, and .5 per cent phosphor-tin, 0.40 per cent.

To provide additional manufacturing facilities to meet the growing demand for its freight trucks, the Automatic Transportation Co., Buffalo, will erect an addition to its plant which practically will double the present floor space. The building will be two stories high and will be similar in construction to those already erected. The new addition is expected to be in operation in September and will be devoted to the manufacture of industrial freight trucks.

Use of the Oxy-Acetylene Torch in Foundries

How Risers, Shrink-Heads, etc., Are Removed Economically by This Process, With Data on Welding Cast Iron and Steel

By H Cole Estep

IN A certain western city there are two jobbing foundries in the same block. One makes a large number of special heavy pipe fittings for the local gas company and the other turns out a great many bulky machinery castings. The managers of these shops were having lunch together one day and the talk drifted around to the subject of losses through accidental breaks, blow-holes, and surface defects in castings. "Only this morning," complained the manager of the pipe-fitting shop, "our foreman showed me a special valve casting weighing over 900 pounds on its way to the scrap pile because of a small accidental break and two blow-holes." "We have recently installed an oxy-acetylene welding outfit in our plant," said the other foundryman, "and if you wish, would be glad to try it out on your valve casting. We have been using the apparatus only two weeks, but were greatly surprised at the savings effected."

Accordingly, the valve casting was rescued from the scrap pile beside the skull cracker and carried around to the neighboring shop. Here, with the aid of the oxy-acetylene apparatus, the break was welded and the blow-holes repaired with new metal in a little less than two hours. The cost of the job for labor, material and gases figured $2.60 and the casting was worth $50.

Incidents somewhat similar to this, repeated in all parts of the country, have created a widespread interest among foundrymen in the subject of autogenous welding and cutting. Nevertheless, the improvements in the process and apparatus during the past few years have been so extensive that progressive superintendents and managers have had difficulty in keeping pace with the developments, while many shop executives are only vaguely familiar with the technical and economic possibilities of the oxy-acetylene blowpipe in foundry operation. The combustion of oxygen and acetylene in a properly constructed blowpipe forms sufficient heat to cut steel rapidly and also to weld cast iron, steel, copper, aluminum and other metals by a true fusion process. The field for the application of this system of welding and cutting in foundry practice is almost unlimited in its extent and variety.

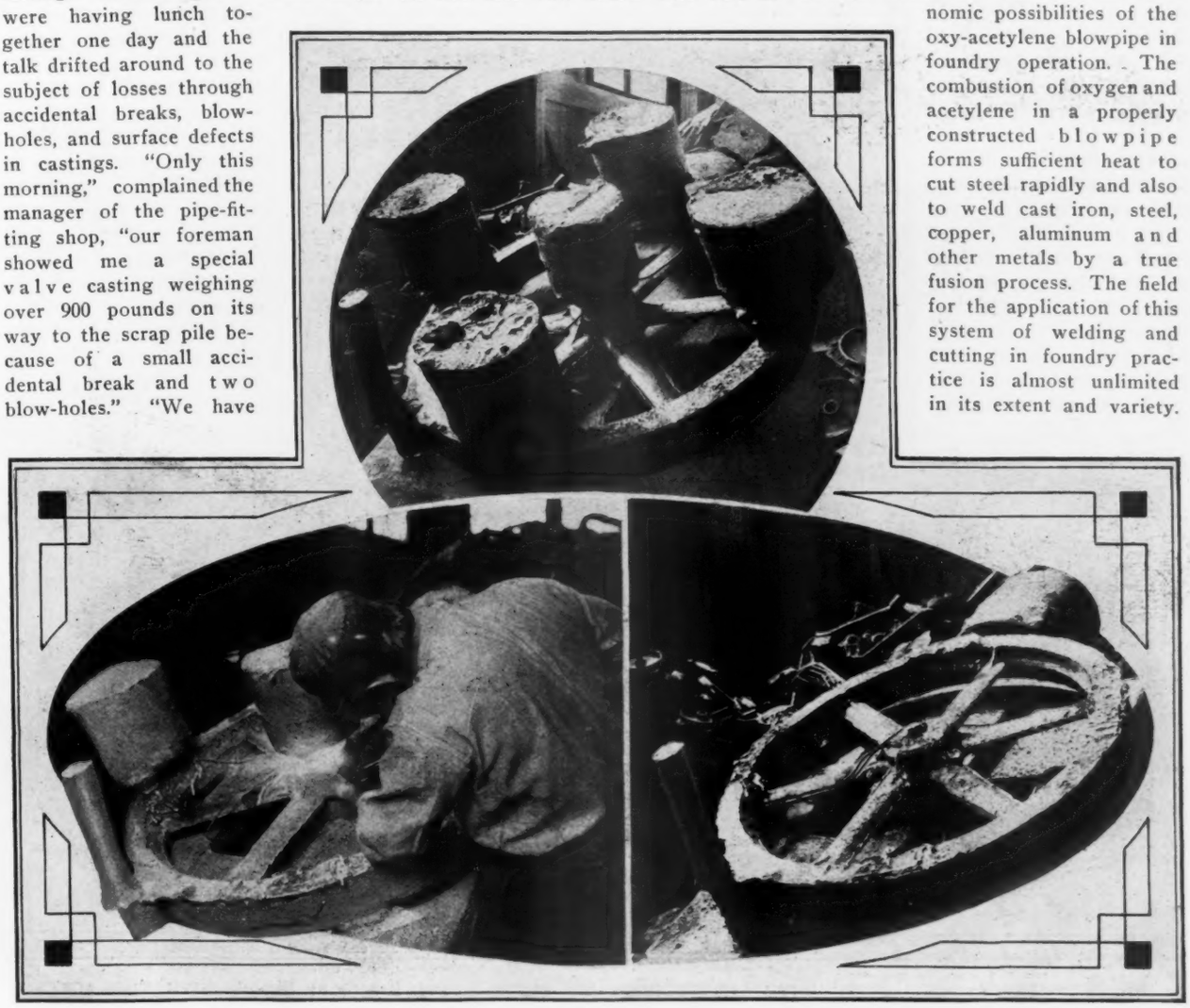


FIG. 1—RISERS ON CAST STEEL FLYWHEEL BEFORE CUTTING
FIG. 2—CUTTING THE RISERS FROM THE WHEEL FIG. 3—HALF AN HOUR LATER—THE JOB COMPLETED

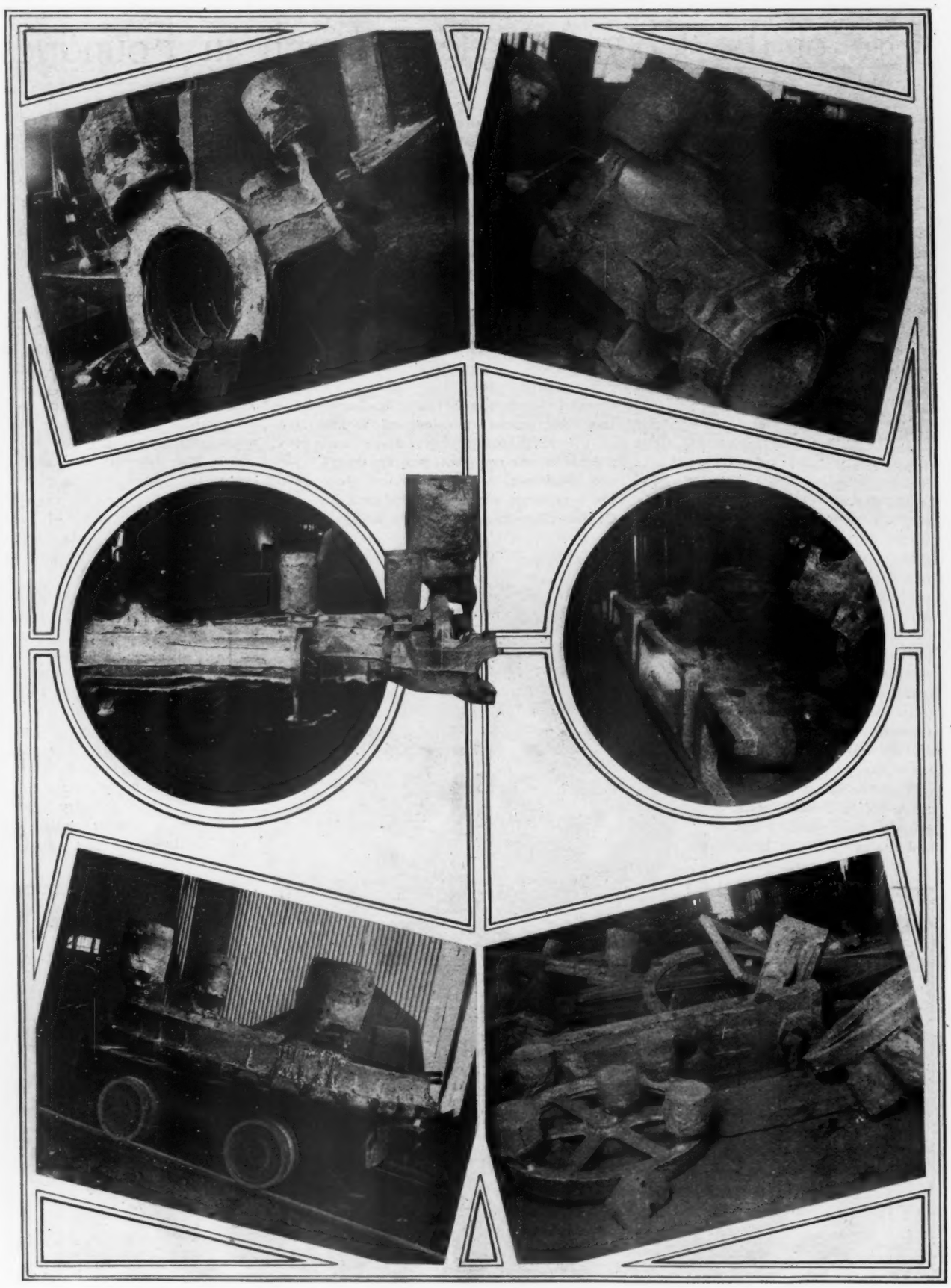


FIG. 4—HEAVY STEEL CASTING WITH SHRINK-HEADS
FIG. 6—THESE SHRINK-HEADS WERE REMOVED IN 42 MINUTES
FIG. 8—FURNACE CASTING MOUNTED ON TRUCK WITH RISERS CUT THROUGH

FIG. 5—CUTTING SHRINK-HEADS WITH THE ACETYLENE BLOW-PIPE
FIG. 7—CUTTING RISERS FROM LOCOMOTIVE SIDE FRAME
FIG. 9—SAVING CRANE SERVICE—A LOT OF ROUGH CASTINGS READY FOR THE CUTTING TORCH

In steel foundries, the oxy-acetylene torch has proved to be exceptionally efficient in cutting off risers and heavy shrink heads, as well as for cutting scrap and welding defective work. In gray iron foundries the process is used for welding blow-holes, surface cracks and other defects in castings, for adding metal in certain places to accommodate changes in design or to rectify mistakes in patternmaking and also for the general repair of the machinery and equipment used in the shop. Oxy-acetylene apparatus may also be employed economically in aluminum and brass foundries for welding.

For cutting steel, a torch provided with two openings is necessary. One orifice carries a mixture of oxygen and acetylene forming a pre-heating flame, while the other delivers a stream of pure oxygen under pressure which oxidizes the metal with extreme rapidity and blows it in the form of iron oxide from the path of the flame. Great improvements have been made recently in the design of cutting torches. One of the most modern blow-pipes is that manufactured by the Oxweld Acetylene Co., Chicago. There are six triangular preheating jets in the Oxweld torch arranged in a circle surrounding the oxygen tube and, therefore, the preheating flame is always in advance of the cutting flame regardless of the direction in which the torch is moved.

As previously suggested, the oxy-acetylene process finds one of its most useful applications in steel foundries for cutting off risers and shrink heads. The cost of this work is approximately 1.40 cents per square inch, including gas and labor. The method is more rapid than sawing and also is said to be handier because heavy castings do not have to be especially placed or adjusted in a machine. The speed at which the work can be done is high, varying from 65 feet per hour for metal ¼ inch in thickness to 5 feet per hour for metal 12 inches thick. It is also said that the cost of cutting steel ¼-inch thick is about 2 cents per lineal foot and about $3.50 per foot for 12-inch plates. One of the largest steel foundries in the country has reported a saving amounting to 12 cents per ton on its total output due to the use of this process for cutting risers. Some specific instances of the economies effected may be interesting.

Fig. 4 shows a large steel pump casting weighing 2,200 pounds. As it came from the mold, it had six heavy shrink heads, the one on the flange being unusually large. The risers ranged from 2½ x 7 inches in cross-section to 4½ x 15 inches. Fig. 5 shows a workman starting to cut off these risers with an oxy-acetylene torch. He finished the job in 20 minutes, consuming 140 cubic feet of oxygen. The foundry foreman estimated that at least six hours would have been required to cut the risers with a saw and the services of a crane would have been necessary six times to change the setting of the casting.

In Fig. 1 is shown a heavy steel flywheel with five large shrink heads and one riser. In Fig. 2 the workman is seen removing the shrink heads and Fig. 3 shows the completed job. About one-half hour was required for the work. Fig. 6 illustrates a steel casting weighing a ton with six risers, ranging in size from 2½ x 7 inches to 5 x 16 inches. With the oxy-acetylene torch, they were cut off in 42 minutes, consuming 160 cubic feet of oxygen. It is estimated that six hours would have been required to do the same work by any other method. Fig. 7 shows another application of the cutting torch in removing risers. The casting, a locomotive side frame, weighed 2,000 pounds. The risers were 2½ x 9 inches, the cross-section of each being 22½ square inches. Six risers were cut in one-half hour by one man using 75 cubic feet of oxy-

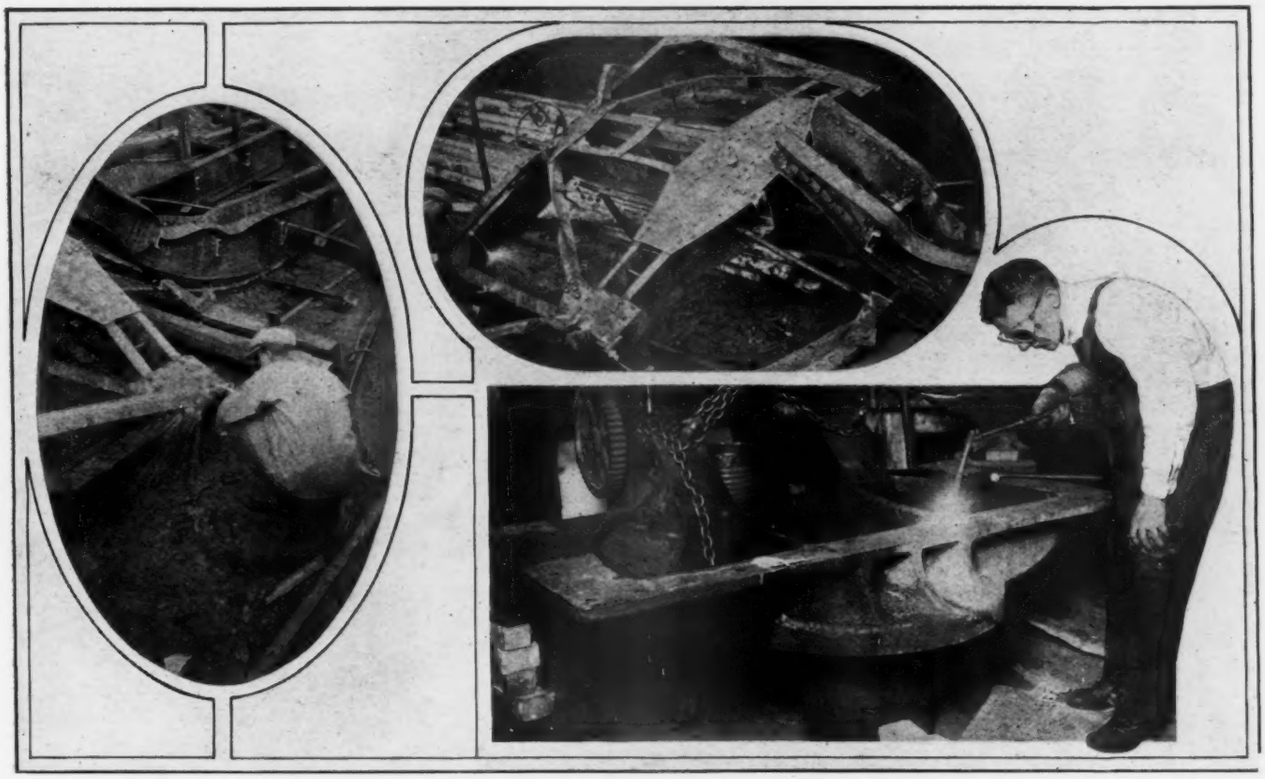


FIG. 10—CUTTING SCRAP STRUCTURAL STEEL AT A COST OF $1.35 PER TON

FIG. 11—CUTTING TWISTED CAR FRAMES IN A STEEL FOUNDRY SCRAP YARD
FIG. 12—WELDING A STEAM SHOVEL CENTER CASTING

gen. The cost of the work was about 31½ cents per riser for material and labor.

Frequently it is convenient to place the casting on a truck, Fig. 8, before the risers are cut off, so that no further handling will be necessary to deliver the work to the machine shop. The casting in this illustration weighed 5,600 pounds. The four risers were 4 inches thick and 14 inches long. They were cut off in 20 minutes, using 125 cubic feet of oxygen. The total cost of the work was estimated to be $3.15. About five hours would have been required to saw the risers off.

The oxy-acetylene torch is particularly useful for this class of work because the castings may be operated on either in the cleaning room or in the main foundry, just as they happen to lie when they come out of the sand. This condition is clearly illustrated in Fig. 9, which shows a number of steel castings piled up together without much attempt at arrangement. Nevertheless, all of the risers are accessible by the cutting torch and practically no crane service would be necessary in removing them.

The cutting torch is as useful in the scrap yard as it is in the shop and frequently a considerable saving may be realized by buying uncut scrap and reducing it to suitable sizes at the foundry. For instance, at the present time scrap steel in uncut fire boxes is worth about $6 a ton, f. o. b. Chicago, as compared with $10.75 when cut into sheets that can be put under the shears. This represents a gain in value of over 75 per cent, the most of which is saved to the foundryman who cuts up his own material. The flexibility of the oxy-acetylene blowpipe makes it especially adaptable to this work; horizontal, vertical, transverse or circular cuts are all made with equal ease and speed. Specially skillful mechanics are not required, as the operation of the blowpipe may be mastered by the average workman with ordinary intelligence in a few hours. As he becomes familiar with the tool in practice, greater rapidity will naturally follow.

The cost of cutting steel scrap varies on different operations. Rust and scale tend to retard the speed of the work somewhat. An operator recently cut two 20-ton steel fire box boilers into scrap prepared for the shears in 12 hours. More than 300 lineal feet of cutting was made through ⅞-inch plate. The total cost of the oxygen, acetylene and labor was $24.10 per fire box or $1.22 per ton. A 10-ton boiler was reduced to scrap ready for the shears by one operator with a blowpipe in nine hours at a total cost of $16 or $1.60 a ton. A 5-ton car frame, Fig. 11, was cut in 21 hours at an average cost of $2 a ton. It was reduced to 4½-foot lengths. A record kept by a prominent western steel foundry covering the cutting of about 12,000 pounds of wrecked steel car frames shows a total cost of $8.10 or $1.35 per ton.

The oxy-acetylene torch may be used in steel foundries for welding

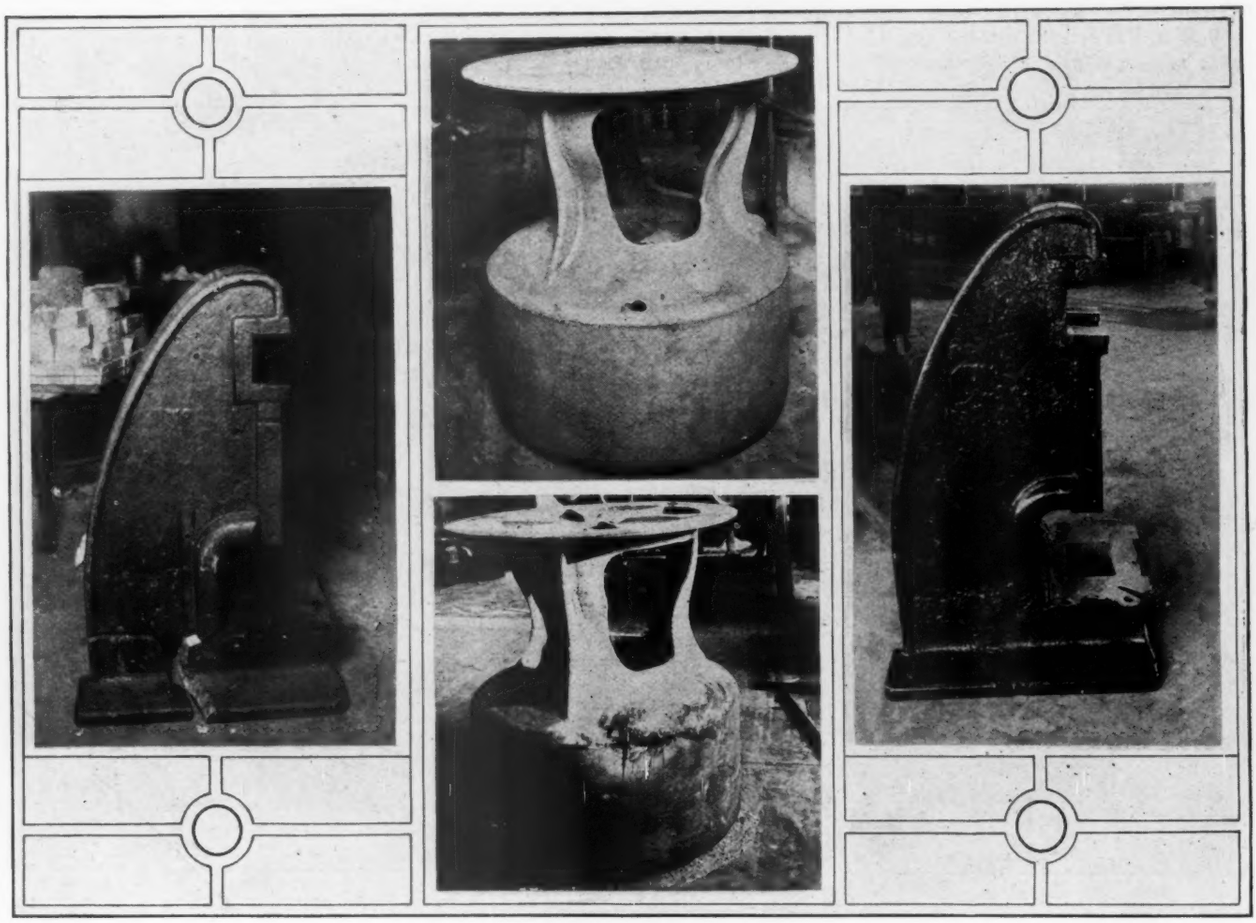


FIG. 13 — A BADLY BROKEN PUNCH FRAME VALUED AT $75

FIG. 14—BLOW-HOLE IN A CAST IRON TURBINE CASING, RENDERING IT UNFIT FOR SERVICE
FIG. 15—CASTING, FIG. 14, WITH BLOW-HOLE WELDED

FIG. 16 — PUNCH FRAME, FIG. 13, WELDED AT A COST OF $7.82

as well as cutting. Fig. 12 shows a steel center casting for a steam shovel which contained some slight defects near one of the ribs. This was completely welded up in five hours, the total cost being as follows:

Operator's time, five hours	$1.71
Helper's time, five hours	1.70
Oxygen	3.38
Acetylene	1.15
Filler wire, 6 pounds at 12 cents	.72
Total	$8.66

In the gray iron foundries, the blowpipe may be used only for welding as it is not possible to cut cast iron. Nevertheless, its field of application is large. Cast iron cannot be cut because of the high percentage of uncombined carbon silicon which it contains. These elements will not oxidize under the highest temperature that it is possible to obtain with the welding torch. In fact, since the cutting process is entirely the result of chemical action, it will not be successful on any metal which does not rapidly oxidize after it reaches a temperature of from 1,500 to 2,000 degrees Fahr.

In considering the economy of the oxy-acetylene process for welding defective gray iron castings, it is safe to assert that provided a blow-hole, crack or other defect can be repaired in a reasonable time, and if the casting is fairly heavy money will be saved. This is a fair working statement. Where very light castings are produced, it is generally more economical to throw the defective work back into the cupola.

Fig. 14 shows a gray iron turbine casing which came out of the sand with a small shrink hole at one point in the shell. This was completely filled up and welded by the oxy-acetylene process. Forty cubic feet of oxygen and 30⅛ cubic feet of acetylene were required, together with one hour for the welding and three hours for pre-heating with charcoal. The casing weighed 500 pounds and was 3 feet in diameter and 4 feet high. Had it not been possible to weld the defects, the casting would have been a total loss to the foundryman.

Fig. 13 shows a punch press casting, accidentally broken into three parts. The same casting when repaired is illustrated in Fig. 16. The frame weighed 500 pounds and was valued at $75. It was 4½ feet high and 2½ feet wide at the bottom and from ¾ to 1¼ inches in thickness. The cost of the welding in detail is as follows:

Operator's time, 8½ hours	$2.55
Helper's time, 8½ hours	2.29
Oxygen, 425 cubic feet	8.50
Acetylene, 327 cubic feet	3.27
Cast iron filler, 4 pounds	.60
Pre-heating, 4 hours with gas	.60
Total	$17.81

A cast iron flywheel weighing 1,200 pounds and valued at $50 had two

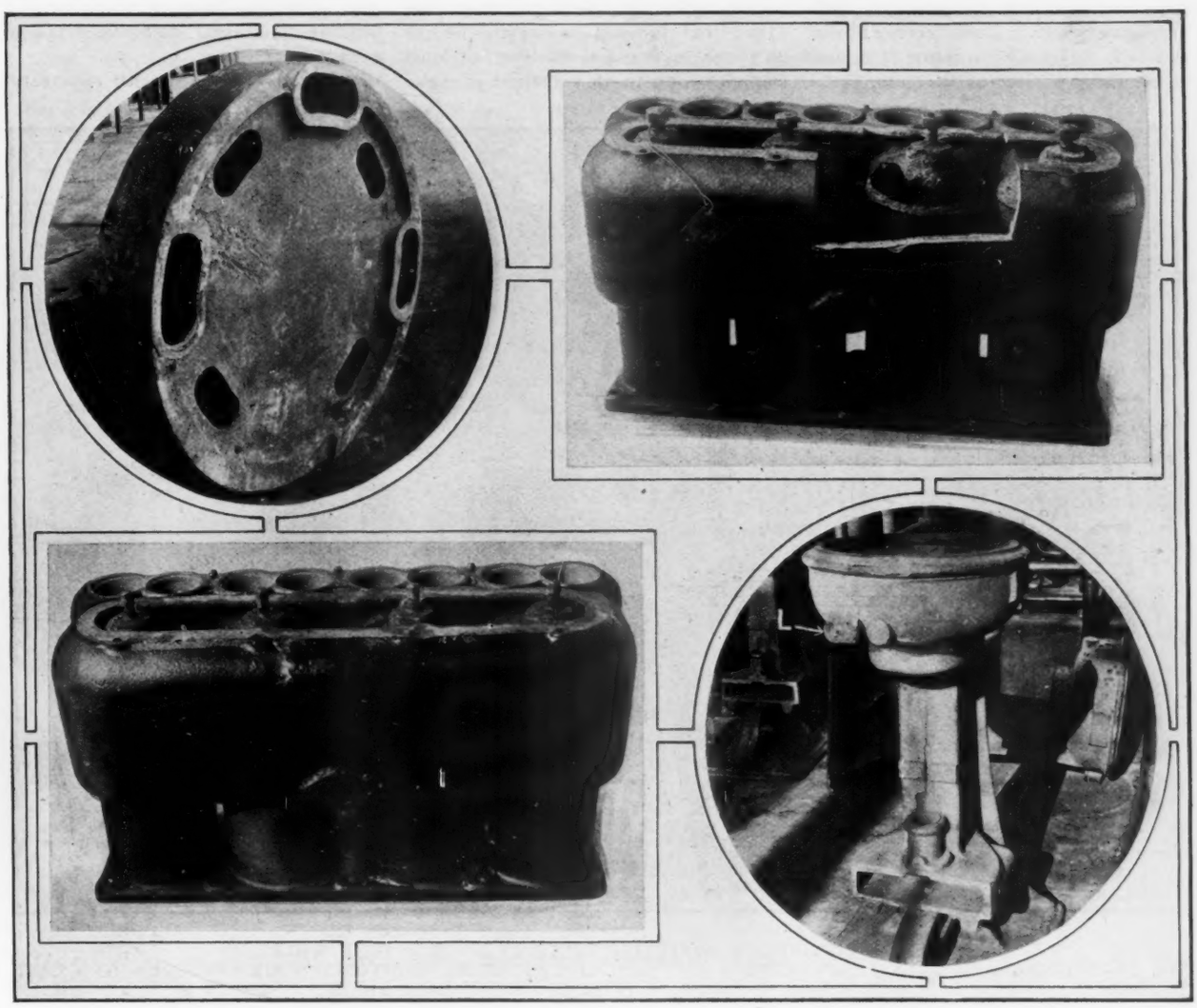


FIG. 17—CRACK WELDED IN A GRAY IRON HEATING BOILER SECTION

FIG. 18—AUTOMOBILE ENGINE CYLINDER WITH DEFECTIVE WATER JACKET

FIG. 19—THE WATER JACKET WELDED AT A COST OF $3.73

FIG. 20—A LUG BUILT ONTO A CREAM SEPARATOR CASTING

blow-holes, one 6 x 3½ x 2½ inches and the other 3 x 2 x 2½ inches. Under ordinary foundry practice this would have been scrapped and a loss of $43.50 charged off, the scrap value of the wheel being only $6.50. The blow-holes, however, were welded by the oxy-acetylene process at a cost of $14.90.

In automobile cylinder foundries, the losses are often high due to the fact that cores are frequently misplaced causing leaks in the thin water jacket walls. It is usually possible to weld these successfully and economically and it is advisable in many instances to cut away a piece of the outer jacket wall to get at an internal defect, as shown in Fig. 18. The total cost of welding both the inner wall and cutting out and replacing the outer jacket in this instance was only $3.73, including gases, labor and supplies.

The annoyance and losses resulting from mistakes in patternmaking and eleventh-hour changes in the design of machinery, can only be fully appreciated by a superintendent who has had charge of a large manufacturing foundry. In many cases this waste can be checked through the intelligent use of the oxy-acetylene process. The blowpipe may be utilized in building-up parts of castings and otherwise altering their shape so as to rectify mistakes or fulfill the requirements of the designer. Fig. 25 illustrates a job of this character, the castings shown being part of a lot of special, air-cooled cylinders that recently went through a large foundry. Each cylinder was 4½ inches in diameter with a 5-inch stroke. They were cast, machined and the connections threaded ready for use, but when turned over to the assembling department it was found that the lug on which the oil pipe was supposed to fit was not long enough owing to an oversight in making the pattern. Each casting was valued at from $10 to $12 and for certain reasons it was impracticable to lengthen the oil pipe. As there were about 50 castings in the entire lot, it does not take much figuring to realize that the loss involved was considerable, to say nothing of the time wasted. But instead of casting a new batch of cylinders, the defective ones were reclaimed with the oxy-acetylene blowpipe. Each cylinder was preheated locally and new metal was built on to the oil connection until it was the proper length, after which a thread was cut and the cylinders fitted as well as though there had been no error. The average cost of the work was from 20 to 28 cents per casting.

Fig. 20 illustrates a cream separator casting, to which a small lug, *L*, was added by the oxy-acetylene blow-pipe, thus accommodating a change in design. The castings were worth about $25 each and were welded at a cost of approximately 35 cents apiece. Fifteen minutes were required to weld each one. Fig. 21 shows a novel rig for building-up several defective teeth in a large gear wheel.

A foundry equipped with oxy-acetylene apparatus will find that it is possible to effect considerable economies in the repair of the machinery and equipment used throughout the shop. A pertinent example of the savings possible in this direction is embodied in the table (page 450), which shows in detail the savings effected by welding worn-out machinery in the shops of the Indianapolis Traction & Terminal Co., Indianapolis, Ind., during the month of June, 1912. The total, it will be noted, was $857.39.

Fig. 22 shows how a broken shaft hanger in a gray iron foundry was

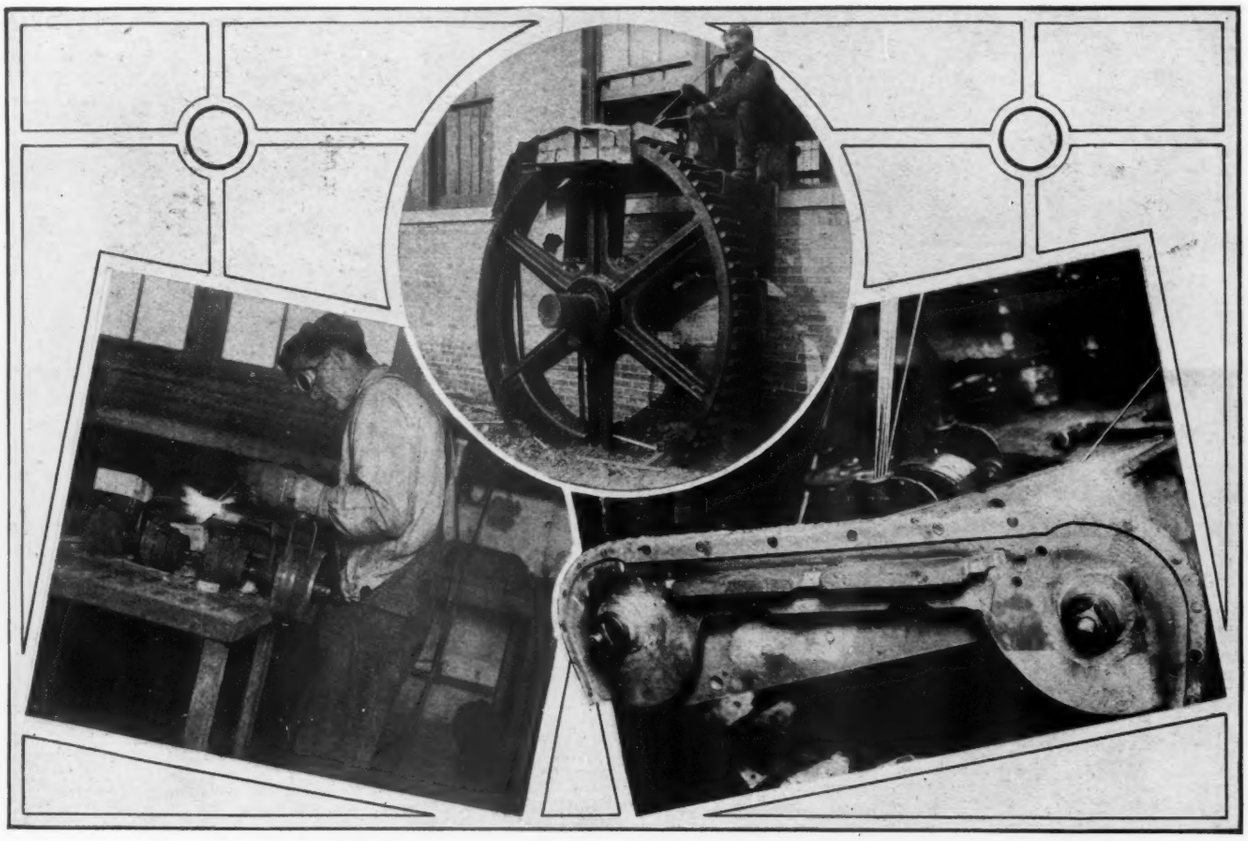


FIG. 21—BUILDING-UP DEFECTIVE TEETH IN A LARGE GEAR WHEEL

FIG. 22—WELDING A BROKEN SHAFT HANGER

FIG. 23—TOOL STEEL REINFORCING STRIP WELDED TO A CAST IRON FRAME

rescued from the scrap pile and welded practically as good as new in 55 minutes at a fraction of the cost of a new part. Another angle to this same problem is brought out in Fig. 23. This shows a mine cutter head which was originally riveted along the reinforcing rail. Under ordinary conditions of use the rivets wear through in a comparatively short time, rendering the cutter unfit for service until the parts can be repaired and new rivets put in. This difficulty was avoided by welding a reinforcing strip of tool steel to the affected part. The welding was done at a cost of 51 cents.

The claim of 100 per cent efficiency for the strength of oxy-acetylene welds is not made by even the most enthusiastic, 95 per cent being about as high as may be obtained. In many cases the tensile strength and efficiency of the weld is increased by hammering lightly while at the proper temperature and by annealing the piece. The operator may also build-up the weld so that the section is enlarged, thus increasing the strength of the joint.

Many of the failures that have been attributed to the oxy-acetylene process are due to the fact that the operator seems to forget his ordinary knowledge of the action of metals under heat. Due allowance must be made for expansion and contraction and also for oxidation in this as in any other fusion or casting process. The flame of the welding blow-pipe has no tendency to appreciably change the chemical contents of gray iron. However, difficulty was at one time met in welding this metal on account of the weld tending to be porous after it was finished. This has been overcome by adding a suitable flux containing principally borax, which slightly lowers the fusion temperature of the iron.

In welding cast iron it has been found good practice to use a *filling-in* rod, which is fused by the flame to the original material being welded. By experiment it has been demonstrated that a cast iron rod, containing about 3 per cent silicon and other ingredients gives the most satisfactory results. The high percentage of silicon, through its influence on the carbon of the iron, reduces the hardness of the weld so that it may be easily machined.

The contraction and expansion of gray iron should be taken care of by preheating and annealing, the value of which cannot be too strongly emphasized with this class of work. Preheating the whole part to be welded to a temperature of about 1,000 to 1,500 degrees Fahr. evenly distributes the expansion throughout the entire casting, preventing an unusual strain in any part. This same principle applies after the weld has been finished; annealing will bring the entire casting up to an even temperature, so that when it cools, the contraction takes place uniformly throughout the whole structure. Care must be taken, of course, while preheating and annealing, to avoid warping the casting.

The most satisfactory and economical method of preheating and annealing large iron castings is with charcoal and compressed air, principally because the casting can be left on the fire while the welding is being done. For small castings probably the most satisfactory method is with a burner, using oil and compressed air.

With all metals which tend to oxidize readily at high temperatures, a flame having a slight excess of acetylene should be used and a smaller amount of oxygen is required than for welding the same thickness of work in steel. This reduces the temperature of the flame and gives the operator better control of the molten metal. In a properly constructed blowpipe the amount of either acetylene or oxygen used may be instantly regulated so that any desired quality of flame may be produced, either reducing, neutral or oxidizing in character, depending upon the class of work to be done.

There are two recognized systems of generating the acetylene used in the process in this country and abroad, namely high and low pressure. The low pressure system is that which

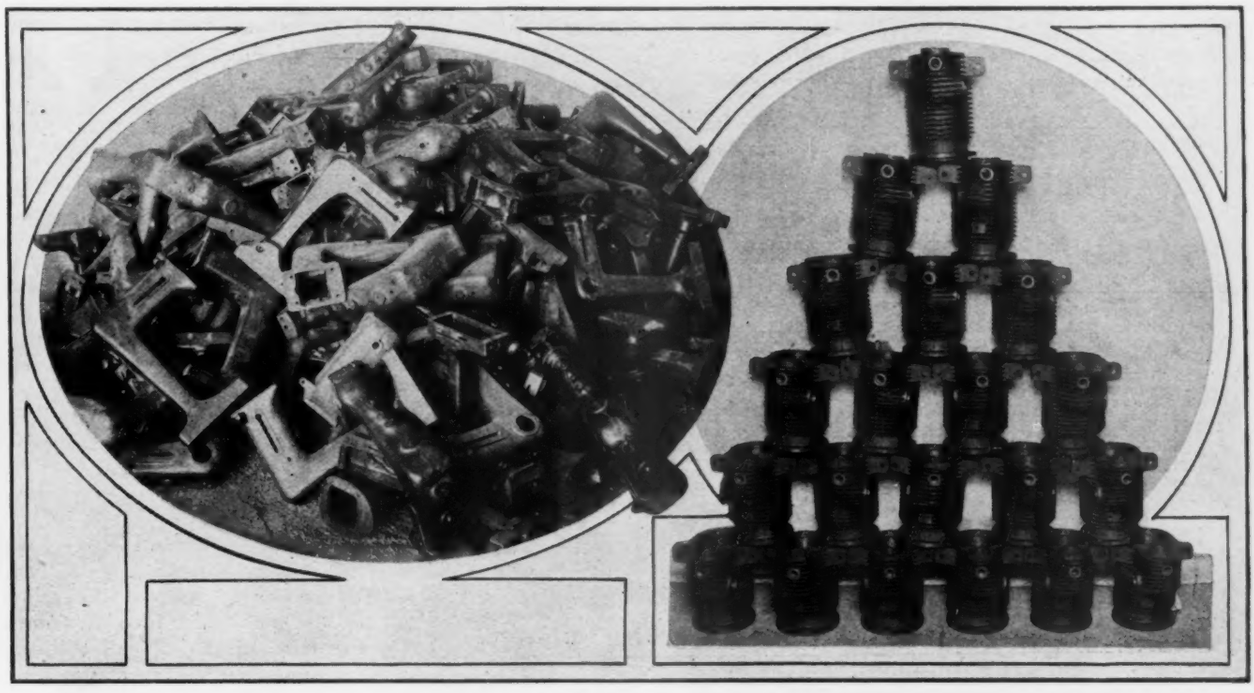


FIG. 24—A LOT OF DEFECTIVE SEWING MACHINE CASTINGS RESCUED FROM THE SCRAP PILE

FIG. 25—LUGS WELDED ONTO AUTOMOBILE CYLINDERS, THEREBY CORRECTING A MISTAKE IN PATTERN-MAKING

delivers acetylene directly from the generator to the blow-pipe under a pressure of a few ounces only. With this system, a uniform pressure is maintained at all times, which is an essential requirement. The high pressure system is that which delivers the acetylene to the blow-pipe under a pressure of more than one pound per square inch. It is supplied by a generator operating under 15 pounds or by acetylene compressed or dissolved in steel tanks. A diaphragm reducer is used. This system gives excellent results, especially for emergency work, where portability is an essential feature. Both systems have their advantages under certain conditions.

The low pressure system, however, is more generally recognized in this country and abroad as completely solving the multitude of problems that the process is called to solve in foundries and machine shops.

When autogeneous welding was first introduced in this country no adequate supply of oxygen was available, and as oxygen is the most important element demanded by the process, this was a serious drawback. Oxygen was generated chemically from potassium chlorate at high cost and with a low per cent of purity. This not only prohibited the use of the process in many cases from the standpoint of economy, but also gave poor results on all classes of work because of the chemical effects of the impure flame.

After the failure of this method, came the introduction of the liquid air process for the manufacture of oxygen, which produces a gas with a high per cent of purity sold to the consumer at a low cost. There are at the present time about six large oxygen-producing plants in this country, and other new plants are in process of construction. To take care of the requirements of this rapidly growing industry, it is not improbable that before many years have elapsed there will undoubtedly be an oxygen plant in every city of note in the country.

Aside from the machine for generating acetylene, the steel bottles for storing the oxygen and the blowpipe with its necessary hose, but little special apparatus is required. In a foundry it is generally advisable to fit up a small room or a corner of the shop where most of the work can be done. This should be provided with piping both for acetylene and ordinary illuminating gas with suitable outlets. Wooden benches may be used, but steel tables with heavy slotted cast iron tops about two inches thick have been found more satisfactory. Such tables could be made in any foundry. For cutting-off risers in steel foundries and for work in the scrap yard, the portable apparatus furnished by various manufacturers of oxy-acetylene equipment will be found almost indispensable.

The oxy-acetylene blowpipe may be used to advantage in brass and aluminum foundries as well as in iron and steel shops. In welding aluminum it is customary to counteract its natural tendency to oxidation by using a flux which breaks down the oxide, and prevents oxidation of the metal when under fusion. A compound containing lithium, potassium, sodium chloride and other elements performs this function with success, and is now used in all cases where aluminum is to be welded. As with cast iron, pre-heating and annealing effectively prevents undue expansion and contraction. In some cases, cold applications placed around the part to be welded produce the same results by preventing the expansion from extending any distance through the structure. Aluminum being more ductile than cast iron, only a very slight strain will be left in the vicinity of the weld, even if not subsequently annealed.

A badly cracked aluminum transmission case was welded in 30 minutes at a cost of approximately 52 cents. Another casting which required a patch and the building-up of a broken corner was repaired at a total cost of $1.50, including all material, gas and labor.

In welding brass castings, a manganese bronze alloy rod is generally used for filling. This makes a good, strong, homogeneous weld and answers practical purposes. In view of the value of these castings, the welding can generally be accomplished with a wide margin of profit, as it costs practically no more to weld brass than it does gray iron or steel castings.

In welding copper, the tendency to oxidize is taken care of, in addition to using the reducing flame, by covering the surface of the plate with a carefully prepared mixture of potassium phosphate and potassium carbonate to a depth of about ⅛ inch. Upon the application of the flame, the mixture will melt and form a glaze over the surface of the metal, preventing oxidation and assuring good work.

OXY-ACETYLENE WELDING REPORT OF THE INDIANAPOLIS TRACTION & TERMINAL CO., COVERING A PERIOD OF ONE MONTH

Date.—Name of part.	Amount of material. Oxy.	Acet.	Filler.	Time. hours.	Cost of welding.	Cost of duplicate. new part.	Net saving.
1—Motor frame top	150	90	3	12	$7.85	$105.17	$97.32
3—Motor frame top	150	90	3¾	8	6.90	105.17	98.27
4—Axle cap	75	45	3	7	4.57	6.24	1.67
4—Armature br'g hous'g	25	15	1	2	1.86	7.94	6.08
6—Cylinder and crank case	200	120	4	9	9.27	13.12	3.85
6—Pulley for carp. shop	20	12	1	1	1.14	.....	.....
8—Motor frame top	250	150	3	15	11.70	77.76	66.06
8—Cutting anti-clim'r	50	30	.	2	2.05	.....	.....
10—Cutting anti-clim'r	50	30	.	2	2.05	.....	.....
10—Peckham truck fr	250	150	4	12	11.01	47.25	36.24
11—Side bearing for car	80	58	3	4	4.01	.....	.....
12—Lorain motor frame	30	18	1	1	1.26	61.56	60.30
13—Peckham truck fr	220	135	3	12	10.09	44.25	34.16
14—Lorain motor fr	30	18	1	1	1.26	61.56	60.30
14—Peckham truck fr	220	135	4	13	10.42	44.25	33.83
17—Peckham truck fr	150	90	2½	10	7.32	44.25	36.93
18—Peckham truck fr	120	72	2¼	10	6.46	47.25	40.79
22—Motor frame top	160	93	2½	10	7.60	105.17	97.57
24—Eight motor axle caps	40	24	1½	2	1.84	44.72	42.88
27—Motor frame top	300	180	4¼	20	14.58	77.76	63.18
30—Motor frame bot	400	240	9	25	19.24	97.20	77.96
Total net saving							$857.39

Repairing Silicon-Copper Castings

A large eastern manufacturer of acid distilling apparatus recently had an opportunity to test out the value of the oxy-acetylene process on silicon-copper castings. These castings as they came from the shop, appeared to be perfect, but after they had been placed in service it was discovered that many porous spots existed through which the acid liquids leaked to the atmosphere. These leaks, while not particularly serious so far as loss of material was concerned, contaminated the surrounding atmosphere to such an extent that it was impossible to work with any degree of comfort. At first it appeared that it would be necessary to scrap six or seven of the largest and most expensive castings included in the distilling apparatus. They had an approximate value of $75 each.

As a last resort, the oxy-acetylene process was tried on the job. Five of the castings were of rectangular box design and each one contained two baffle trays which were cast solid with

(*Continued on page* 455.)

Calculating Mixtures for Malleable Cast Iron--I

A Rapid and Easy Method for Figuring the Heats

How the Problem is Solved by Use of Base Numbers

By Harrold Hemenway

IN calculating mixtures for malleable cast iron, a great many adverse conditions arise, owing to the fact that no two furnaces work alike. For this reason it is impossible to run the same mixture in all furnaces and, in fact, it is necessary to slightly vary the mixture in each furnace from time to time as conditions demand. However, it resolves itself into a knowledge of these conditions as to what is the proper mixture to be charged, so as to keep the finished product within certain well defined limits. When making a mixture, one must take into consideration the amount of blast pressure, together with the size of the bung blast pipes, which admit the air over the top of the metal. This has a controlling influence on the amount of silicon, which will be burned out during the time the metal is continued in the furnace to allow melting down and to bring the carbon into complete combination. The size of the heat required must also be taken into consideration, as in larger heats, the number of square inches of metal on the top exposed to the blast, is not increased in proportion to the depth of the metal. For this reason it is impossible to safely advise the amount of silicon a mixture should contain when charged, which at the time of pouring would be suitable for a certain class of work. This is a local condition which must be determined by the one calculating the mixture. The operator of the furnace should so understand conditions that he is not compelled to tap the heats at a certain time after skimming, but should know by the appearance of the metal at the time of skimming, how soon a test must be taken to see whether the carbon is completely combined. By cooling a test piece which will show the condition of the carbon, together with the appearance of the metal in the test ladle at the time of testing, will prove whether the original calculation was correct, or whether it is necessary to increase or decrease the amount of silicon required in the next heat, so as to have the carbon completely combined, when the metal is sufficiently heated, to run the class of work being made at that particular furnace. Taking for granted that the pig iron to be used is either charcoal or coke, purchased within the strict limits of the malleable Bessemer specifications, the metalloids, sulphur, phosphorus and manganese, will not be considered, as under ordinary furnace conditions these will be in the correct proportions. We, therefore, will consider the influence of silicon, which, of all the metalloids contained in pig iron, is probably the one upon which the greatest dependence is placed. It is conceded that silicon promotes the separation of graphitic carbon and in the malleable casting, carbon is one of the most important metalloids. In calculating a mixture, it is not necessary to figure the carbon contents, for when the other elements are within the proper limits, the percentage of silicon should indicate the proportion of combined and graphitic carbons. For this reason it is useless to specify any carbon or form of carbon in the pig iron for malleable, for the carbon point below which it is impossible to anneal is well defined and never is reached even by the amount of steel scrap it is possible to add satisfactorily to the mixture. While the presence of silicon is a necessity in the melting furnace, for if not present in sufficient quantity, the iron would burn and would be honeycombed when poured, still an excess of silicon is a hindrance in the annealing process. For the average malleable casting, the silicon in the hard iron should be between 0.60 and 0.75 per cent; 0.65 per cent would be a fair average. In making a malleable mixture, the first factor to be considered is the amount of sprues to be used, together with the amounts of malleable and steel scrap. Let us consider the sprue graded as No. 5 iron, having the silicon at 0.60 per cent as a constant. This will work out to the best advantage even though the silicon in some heats will analyze 0.75 per cent or higher. The total percentage of carbon in the sprue is much lower than the total percentage of carbon in the pig iron, and by figuring this at a lower percentage, some allowance is made for this reduction in carbon. In calculating malleable mixtures using the sprue graded as a No. 5 iron, it will be easy to make a mixture using the pig iron graded as Nos. 1, 2, 3 and 4, having the approximate relative proportion as nearly as possible to the sprue figured at 0.60 per cent silicon, and used as a No. 5 iron. The method of figuring the mixture is indicated in Table I. In calculating a mixture by the method outlined in Table I, the different amounts used are always figured in even hundred pounds. For this reason it is not necessary to consider the two ciphers in figuring a mixture. Therefore, the two ciphers have not been taken into

Harrold Hemenway

Harrold Hemenway, the author of "Calculating Mixtures for Malleable Cast Iron," has had a wide experience in malleable foundry work. Born in Moline, Ill., Sept. 14, 1880, he attended the public schools of that city and graduated from high school in 1898. In the summer of the following year he entered the employ of the Union Malleable Iron Co. in the capacity of draftsman and assisted in the designing of the melting furnaces for this company's new plant erected at East Moline, Ill. For nine years Mr. Hemenway was affiliated with this company and during this period he held different positions which afforded him an opportunity to gain a wide experience in all branches of foundry work. During a large part of this time he had charge of the furnaces and calculated all of the mixtures.

In May, 1908, Mr. Hemenway entered the employ of the H. W. Cooper Saddlery Hardware Mfg. Co., in the capacity of superintendent of its malleable foundry. He designed the melting and annealing furnaces and supervised their installation in this shop and also devised the cost system for the foundry.

consideration in determining the silicon contents of this heat. The mixture shown is for a nine-ton heat and will be figured at 180 instead of 18,000 pounds.

The grade at which the heat is to be figured must be determined first, and in this case is 3.35. Multiplying the grade 3.35 by the size of the heat in pounds, 180, equals 603, the base number from which to calculate the mixture, and the different amounts of pig iron and sprues used when multiplied by their grade numbers and added will equal this base number.

Table I

Method of Calculating a Malleable Mixture.

Brands of pig iron:	Silicon, per cent.	Amount, pounds.	Silicon in mixture.
Federal, No. 1	1.50	3,000 =	45.00
Iroquois, No. 2	1.20	3,500 =	42.00
Nellie, No. 3	0.90	3,600 =	32.40
Malleable scrap*	....	800 =	4.80
Steel scrap* 44 per cent No. 5	0.60	600 =	3.60
Sprue*	....	6,500 =	39.00
		18,000 =	166.80

166.80 ÷ 180 = 0.926 per cent of silicon the mixture contains.
The grade at which the heat is figured is 3.35.
The grade, 3.35 × 180, the size of the heat in pounds, equals 603, the base number.
603 — 597 = +6
30 No. 1 + 36 No. 3 = 66.
101 sprues and scrap — 66 = 35 No. 2.

*These three amounts constitute the No. 5 iron in the mixture.

Calculating the Grade

In estimating the grade, I first discovered that by using the sprue graded as No. 5 iron and the pig iron graded as No. 2 iron, it was possible to obtain a base number and make a mixture containing all No. 2 pig iron and sprue. However, this was not always practical, as it would not always give the desired silicon contents, and it was necessary to use other grades of pig iron, which were indicated as Nos. 1 and 3. The different amounts of iron and sprues used, when multiplied by their grade numbers and added, give a base number from which to calculate the mixture. By dividing this base number by the size of the heat, gives a number which is termed the grade. Referring to Table I, using the amounts and pig iron grades indicated, the base and grade numbers are ascertained as follows:

Pig iron grade.	Pounds.	
No. 1	3,000 × 1 =	3,000
No. 2	3,500 × 2 =	7 000
No. 3	3,600 × 3 =	10,800
No. 5	7,900 × 5 =	39,500
	18,000	60,300

Pointing off two ciphers, 603 equals the base number and 603 divided by 180 equals 3.35, the grade at which the mixture is figured.

I then discovered that by changing the grade 0.05 points, would give enough change in the silicon contents to warrant changing the mixture to obtain different results in the furnaces.

Since enough changes and different mixtures could be made by varying the grade 0.05 points, I selected the grade numbers, as indicated in Table V, and arranged the heat card accordingly. Any other numbers could be selected for the grade and advanced enough points to make a decided change in the mixture. In changing a heat in daily practice, it is not always possible to make the change at an exact grade without changing two or three grades of iron, while by changing one grade of iron and the sprue will accomplish the desired results. This, for example, may make the grade, 3.34 or 3.36. The heat card which I use in daily practice has the base numbers figured for various size heats, commencing with a grade of 2.75 and advancing by 0.05 to 4.00.

Taking the percentage sprue required, Table I, and subtracting this amount in pounds from the size of the heat in pounds the remainder indicates the amount of pig iron to be used. If all of the pig iron used was to be graded as No. 2 iron and using the sprue as No. 5 iron, a base number for a nine-ton heat using 44 per cent sprue, would be determined as follows:

9-ton heat	180	
44 per cent sprue, No. 5 iron.	—79 × 5 =	395
Pig iron, No. 2 iron	101 × 2 =	202
	180	= 597

In calculating a nine-ton heat having a grade of 3.35 the base number is 603 and the base number using 44 per cent sprue is 597. Subtracting 597 from 603 leaves a remainder of +6. For this reason it is necessary to use 600 pounds more of No. 3 iron than No. 1 iron to obtain a grade of 3.35, making the amounts of iron used when multiplied by their grade numbers and added equal 603. Using 3,000 pounds of No. 1 iron added to +6 equals 3,600 pounds of No. 3 iron, and these added and the result subtracted from 10,100 pounds equals 3,500 pounds of the No. 2 iron required. The calculation is proved as follows:

No. 1 Iron	30 × 1 =	30
No. 2 Iron	35 × 2 =	70
No. 3 Iron	36 × 3 =	108
Sprue No. 5 Iron	79 × 5 =	395
	180	= 603

the base number from which the calculation is made.

Since the amounts of the different irons used when multiplied by the grade numbers and added equals 603 the grade is 3.35.

In calculating heats by this method the amounts of malleable and steel scrap used are deducted from the amount of sprue used, and for this reason the mixture is written as indicated in Table II.

Since the amounts of malleable and steel scrap used are deducted from the total amount of sprue used, the grade of the heat is raised or lowered as the amounts are increased or decreased. Thus by adding 100 pounds of steel scrap it is necessary to reduce the grade five points, and when leaving out 100 pounds, it is necessary to increase the grade five points. Mal-

Table II

Brands of pig iron.	Silicon, per cent.	Amount, pounds.	Silicon in mixture.
Federal, No. 1	1.50	30 =	45.00
Iroquois, No. 2	1.20	35 =	42.00
Nellie, No. 3	0.90	36 =	*32.40
Sprue, No. 5, 44 per cent	0.60	79 =	47.40
		180 =	166.80

166.80 divided by 180 = 0.926 per cent of silicon the mixture contains.
The grade number is 3.35 and the base is 603.

603
101 597
66 +6
35 No. 2. 30 No. 1.
36 No. 3.
66

Malleable scrap, 800 pounds.
Steel scrap, 600 pounds.

leable scrap does not have the same effect as steel scrap, and it is not necessary to change the grade unless the amounts used are increased or decreased at least 200 to 300 pounds.

To make up the same size heat having the same grade, but using 46 per cent sprue, the calculation is made as shown in Table III.

A Nine-Ton Heat

In calculating a nine-ton heat having a grade of 3.35, the base number is 603 and the base number using 46 per cent sprue is 609. Subtracting 609 from 603 gives a remainder of —6. For this reason it is necessary to use 600 pounds more of No. 1 iron than the No. 3 iron to obtain a grade of 3.35, making the amounts of iron used, when multiplied by their grade numbers and added equal 603. Using 3,000 pounds of No. 3 iron added to —6 equals 3,600 pounds of the No. 1 iron, and these added and the result subtracted from 9,700 pounds equals 3,100 pounds of the No. 2 iron required. The calculation is proved as follows:

No. 1 Iron.....	$36 \times 1 =$	36
No. 2 Iron.....	$31 \times 2 =$	62
No. 3 Iron.....	$30 \times 3 =$	90
Sprue No. 5 Iron.....	$83 \times 5 =$	415
	180	= 603

the base number from which the calculation is made.

Three Heats a Day

Let us now consider the proper way to calculate heats for one furnace running three heats on a cast day, the first heat to be charged into a hot furnace. The calculation would be made as shown in Table IV.

Table IV shows the method of calculating three heats to be run in one furnace and the amounts of malleable and steel scrap must be weighed for each heat and deducted from the amount of sprue used. The second and third heats were originally made out, having the grade five points higher than the first heat. This is a general rule, as the furnace is considerably hotter and would, therefore, handle a higher mixture. Supposing that upon tapping the first heat, the iron was a little dull and not entirely satisfactory for the class of work being made. It is then not desirable to have a higher mixture for the second heat, but a heat must be charged having the same silicon contents. Reducing the grade to 3.35, the base number for an 8½-ton heat having this grade is 570. Subtracting 570 from 578 (the base number used in calculating the heat) leaves a remainder of —8 points. Wanting to run the same size heat it is necessary to change the amounts of pig iron and sprue used to equal —8 points. The change is made as follows:

Take out sprue No. 5 iron	$-2 \times 5 =$	—10
Bring in No. 1 iron	$+2 \times 1 =$	+ 2
	0	= —8

By taking out 200 pounds of sprue, silicon 0.60 per cent, and bringing in 200 pounds of No. 1 iron, silicon 1.50 per cent, the size of the heat has not been changed, but the grade has been reduced five points, which has increased the silicon contents to 0.928 per cent.

Suppose that this mixture proved a little too soft and it was necessary to continue the metal in the furnace a little longer in order to completely combine the carbon. It is then necessary to have a higher mixture for the third heat, and a nine-ton heat is required which is 1,000 pounds larger than the heat which has already been weighed. Increasing the grade to 3.50, the base number for a 9-ton heat having this grade is 630. Subtracting 578 (the base number used in calculating the heat) from 630 gives a remainder of +52 points. For this reason 1,000 pounds must be added to equal +52 points.

The change is made as follows:

Bring in sprue No. 5 iron..	$+11 \times 5 =$	+55
Take out No. 3 iron.....	$-1 \times 3 =$	— 3
	10	= +52

By bringing in 1,100 pounds of sprue, silicon 0.60 per cent, and taking out 100 pounds of No. 3 iron, silicon 0.90 per cent, the heat has been increased to nine tons and the grade has been increased 10 points, which has reduced the silicon contents to 0.898 per cent.

To accomplish this last change it has been necessary to take out 100 pounds of pig iron in order to have the mixture calculated at the exact grade. In every-day practice this

Table III

Calculating a Mixture With 46 Per Cent Sprue.

9-ton heat	180	
46 per cent sprue, No. 5 iron	$-83 \times 5 =$	415
Pig iron, No. 2 iron	$97 \times 2 =$	194
	180	= 609

Brands of pig iron.	Silicon, per cent.	Amount, pounds.	Silicon in mixture.
Federal, No. 1	1.50	36 =	54.00
Iroquois, No. 2	1.20	31 =	37.20
Nellie, No. 3	0.90	30 =	27.00
Sprue, No. 5, 46 per cent	0.60	83 =	49.80
		180 =	168.00

168.00 divided by 180 = 0.933 per cent of silicon the mixture contains.
The grade number is 3.35.

97	603	
66	609	
—	—6	
31 No. 2.	30 No. 3.	
	36 No. 1.	
	66	

Malleable scrap, 800 pounds.
Steel scrap, 600 pounds.

Table IV

Calculating Heats For One Furnace Running Three Heats on a Cast Day.

Brands of pig iron:	Silicon. per cent.	Silicon, 0.926 per cent.	Silicon, 0.928 per cent.	Silicon, 0.898 per cent.
Federal, No. 1	1.50	30	30 + 2 = 32	30
Iroquois, No. 2	1.20	35	28	28
Nellie, No. 3	0.90	36	34	34 — 1 = 33
Sprue, No. 5, 44, 45 and 49 per cent	0.60	79	78 — 2 = 76	78 + 11 = 89
		180	170 — 170	170 — 180
		3.35	3.40 — 3.35	3.40 — 3.50
		603	578 578	578 630
	101	597 92	574 570	574 578
	66	— 64	— —	— —
	—	+6 —	+4 —8	+4 +52
	35*	30‡ 28*	30‡	30‡
		—	—	—
		36**	34** 92	34**
		—	— 64	—
		66	64 —	64
			28*	

Malleable scrap, 800 pounds.
Steel scrap, 600 pounds.

‡No. 1. *No. 2. **No. 3.

would not be done, as there is only 30 points difference between the No. 3 iron and the sprue, so that the easiest and simplest way to make this change would have been to bring in 1,000 pounds of sprue. This would have increased the heat to the required size and also reduced the silicon contents. The changes in the silicon contents for each heat is noted in Table IV, and each day's heats are copied onto a card or into a book for permanent record. This record should show the different irons used, together with the silicon contents and the grade, which will form a basis for future calculations.

In selecting the pig iron for this mixture we determined to use the iron having 1.50 per cent silicon for the No. 1 iron, and as the sprue is figured as No. 5 iron having 0.60 per cent silicon, the No. 2 and No. 3 irons are determined as follows:

	Per cent silicon.
No. 1 iron	1.50
Sprue, No. 5 iron.....	—0.60

$90 \div 3 = 30$, the number of points each grade must increase to be in exact proportion to each other and to the sprue figured as No. 5 iron having 0.60 per cent

	Per cent, silicon.
Sprue, No. 5 iron.....	0.60
	+30
No. 3 iron.....	0.90
	+30
No. 2 iron.....	1.20
	+30
No. 1 iron.....	1.50

This shows that the different grades of irons used in this mixture are in exact proportion to each other.

Let us suppose that it is necessary to change this mixture so as to make a line of lighter castings, for which reason the silicon contents in the mixture must be increased.

In order to use the surplus of sprue to advantage it is necessary to use a much softer grade of pig iron for the No. 1 iron, so as not to reduce the amount of sprue used, but rather be in position to increase this. Upon looking over the stock of pig iron we find a car of iron having silicon, 1.95 per cent. The sprue will be figured as having 0.60 per cent silicon, and any difference (caused by the sprue having more than 0.60 per cent silicon) will be overcome by changing the grade of the heats. The different grades of pig iron are determined as follows:

	Per cent, silicon.
No. 1 iron	1.95
Sprue, No. 5 iron.....	—0.60

$1.35 \div 3 = 45$, the number of points each grade must increase to be in exact proportion to each other and the sprue figured as No. 5 iron having 0.60 per cent silicon.

	Per cent, silicon.
Sprue, No. 5 iron.....	0.60
	+45
No. 3 iron.....	1.05
	+45
No. 2 iron.....	1.50
	+45
No. 1 iron.....	1.95

The No. 1 iron used in the previous mixture can now be used as the No. 2 iron and the No. 2 and No. 3 irons weighed in equal proportions will have an average of 1.05 per cent silicon and can be used as the No. 3 iron in this mixture. It is only necessary to use a quantity of the iron having 1.95 per cent silicon which is the only new iron added to the mixture. Having used the other irons in a former mixture and found that these were running properly, this mixture has been completely changed by the addition of one new iron.

In the examples shown, the different grades of pig iron used are in the exact proportion to each other. It is not always possible to have the different grades in the exact proportion, and while the No. 2 iron might be a few points in excess of the exact ratio, the No. 3 iron may be chosen a few points below the exact ratio, and using these in almost equal quantities will accomplish the same result.

Piling Pig Iron

On pages 74 and 75 of "The Production of Malleable Castings" by Richard Moldenke, he explains his method of piling pig iron into three distinct piles. If this method is used the silicon in the different grades of iron can be specified so as to have the approximate proportion to each other, to fit in with this method of calculating mixtures. It would be advisable, however, to have some irons somewhat higher and lower in silicon in order to be able to make decided changes in the mixture when furnace conditions warrant such changes.

This method can be used for calculating any size heat using any amount of sprue, and having any grade required so as to have the desired silicon contents. Mixtures can be made using a No. 4 grade of pig iron and this may be necessary when running larger heats. These require a higher mixture and owing to the stock of sprues on hand, it may be necessary to use a lower silicon pig iron. Mixtures can be calculated leaving out any one of the three different grades, and using only two grades, or by leaving out two grades and using only one grade of pig iron with the sprue and scrap. If occasion demands that only a limited amount of the No. 2 iron be used, having determined this amount, a mixture can be accurately calculated, using this amount. By this method any quantity of any one grade can be used, and in case of using any off grades of iron, small charges can be made to avoid having the mixture run *off*.

By making a careful study of furnace conditions, the mixture can be calculated and varied, so as to overcome the adverse conditions, and keep the finished product within the proper limits. Malleable and steel scrap have a certain affect upon the mixture and, therefore, should be used in proper proportions, and should not be used excessively except in extreme cases, and then only for a short period of time. The daily analysis of the hard iron test blocks, together with their appearance when broken, will prove whether the mixture is within the proper limits and indicate what slight changes are necessary. Having the amounts of malleable and steel scrap in the proper proportions, the mixture can be varied so as to insure an even

Table V

Card Containing the Base Numbers For the Different Grades, and Also the Different Percentages, Together With the Base Number For the Different Percentages of Sprue and Pig Iron Required For the Different Size Heats.

Grade	3.00	3.05	3.10	3.15	3.20	3.25	3.30	3.35
Size of heat.	Base numbers							
180	540	549	558	567	576	585	594	603
185	555	564	574	583	592	601	611	
190	570	580	589	599	608	618		
195	585	595	605	614	624			
200	600	610	620	630				

Percentages of Sprue and the Proportions of Sprue and Pig Iron Required For Heats of Different Sizes.

Size of heat.	38 per cent.	40 per cent.	42 per cent.	44 per cent.
	564	576	588	597
180	68.112	72.108	76.104	79.101
	580	592	604	613
185	70.115	74.111	78.107	81.104
	596	608	620	632
190	72.118	76.114	80.110	84.106
	612	624	636	648
195	74.121	78.117	82.113	86.109
	628	640	652	664
200	76.124	80.120	84.116	88.112

quality of iron, which, with proper annealing, insures a grade of castings always suitable for a class of work requiring a large amount of drilling and machining.

Mixture Card

To perfect this method and to assist in calculating mixtures, being ready to change promptly, a card is made giving the base number for the different grades, and also the different percentages, together with the base number for the different percentages of sprue and pig iron required for the different size heats. The card is shown in Table V.

For a foundry making a light class of castings which will have the silicon in the hard iron between 0.80 and 1.00 per cent the sprue can be figured at 0.80 per cent silicon, being used as a No. 4 iron. The author used this method in operating furnaces, making light saddlery hardware castings, and during his entire experience has used over 50,000 tons of pig iron by this method without losing a heat.

In the next article I will explain the "Heald" system for silicon, which is the best method known to obtain the exact silicon contents required for any size heat.

Use of the Oxy-Acetylene Torch in Foundries

(*Continued from page* 450.)

three sides of the casing. Great care had to be taken to keep these trays from cracking loose from the side walls when they were preheated and prepared for welding.

The castings were placed in a loose fire brick oven and the metal was then brought to a uniform red heat with an oil burner. The weld was then made while the castings were at this high temperature with the oil burner still in action. After the weld was completed, the oil burner was shut-off, the brick oven covered and the castings were allowed to cool over night. Only one side of the casting could be done at a time, as it was impracticable to turn the piece over while at a red heat. This necessitated heating each piece at least four times and in some cases it was necessary to heat a casting a fifth or sixth time in order to weld defects which happened to be on the inside. To facilitate the work, three brick furnaces were used so that one side of three castings was done each day.

After the castings were completely welded, they were tested under hydrostatic pressure and found tight. A considerable sum of money was saved and a very serious delay avoided.

Operating A Small Cupola

By W. J. Keep

Question.—Our cupola is lined to 32 inches and the heats average from three to four tons daily. We would like to know how heavy our charges should be and how much coke should be placed on the bed. We use 72-hour fuel and would like to have your advice regarding the necessary blast pressure.

Answer. — The question is one of measures before you can decide on weights. Do not use more than one row of tuyeres. Close the upper tuyeres if the furnace is equipped with two sets. The opening in the lower tuyeres should not be more than 4 or 5 inches high and they should be as wide as possible. The distance from the tuyeres to the top of the sand bed should be governed by your needs. If you expect to carry the iron away as fast as melted, this distance should be approximately 10 inches. , However, if you hold the iron for large castings, the tuyeres must be high enough to permit the accumulation of iron. To ascertain the height of your bed, obtain a ¼-inch iron rod and bend one end at right angles for a length of 15 inches. Draw a line with chalk on the inside of the lining 15 inches from the top of the tuyeres and ascertain the distance from this mark to the sill of the charging door, which should be laid off on this rod. Retaining this distance on the rod, bend the other end at right angles in an opposite direction from the other bend. Build the cupola fire two hours before iron is required. Add the coke and let the cupola get hot. Half an hour before the iron is to come down, add sufficient coke on the bed to reach to a point 15 inches above the top of the tuyeres. To facilitate this use the bent rod, hanging one end on the sill of the charging door and add coke until the lower end rests on this fuel. If, for example, you started with 1,000 pounds of coke at the cupola on the charging floor, weigh the coke remaining and you will ascertain the weight of the coke on the bed by subtracting the weight of the coke left from the original amount. The first charge of iron is then made on the bed. You cannot melt with coke if the distance from the bottom of the tuyeres to the sand bottom is less than 10 inches, although this is possible by the use of anthracite coal. The iron charge on the bed and the subsequent charges should be about 7 inches deep. To ascertain the weight of these charges, pile the iron in a circle, 32 inches in diameter and 7 inches high and weigh the metal. The coke charges should completely cover the iron and should be from 4 to 6 inches deep. The coke should average about one-tenth of the weight of the iron for each charge. You can use about half as much coke before the last charge of iron as was employed on the other charges. If you follow these directions and find that the iron is not sufficiently hot, slightly increase the coke charges. When the condition of the iron is satisfactory, increase the iron charges from time to time, but make no change in the coke charges. You will find that if you follow these suggestions you will obtain as good or better results than if we attempted to give you accurate weights. With reference to blast pressure, a small cupola should be operated at a low pressure to prevent cutting the lining and, therefore, the tuyeres must be large. The pressure for a cupola of this size should be from six to eight ounces.

Sheet Steel Match-Plates

For snap flask match-plates, on which small agricultural patterns are mounted, the Sandwich Mfg. Co., Sandwich, Ill., is using No. 10 gage rolled steel sheets instead of the more customary aluminum plates. Ordinary blue annealed stock is purchased. The steel match-plates are about ⅛ inch thick and are said to be much stiffer than the aluminum plates. This is their chief advantage, coupled with the fact that they are cheap and will stand rough usage. It was found that the rapping tongues of the soft aluminum plates are soon badly battered by the molder's mallets, whereas the tongues on the sheet steel plates seem to be practically indestructible. In fact, the tongues on many of the aluminum or white metal plates have been reinforced with small pieces of steel to protect them from destruction.

The match-plates are cut from the sheets as they come from the mill. The patterns are of the usual aluminum or brass composition and are mounted on the plates with the customary dowels, screws or threaded studs.

White Metal Alloy

John Coup, Marion, O., has been granted a patent on a new white metal alloy which, it is claimed, can be substituted for nickel-plated articles for the manufacture of bells, etc. It contains copper, 69.13 per cent; nickel, 14.81 per cent; zinc, 8.64 per cent; aluminum, 3.70 per cent; phosphor tin, 3.08 per cent; lead, 0.58 per cent, and iron, 0.08 per cent.

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Founders' Week at Chicago

FOUNDERS' WEEK will be celebrated at Chicago from Oct. 10 to 17. It promises to be a noteworthy event and merits your support by your attendance and that of every shop executive in your employ. This is your opportunity—the opportunity of your superintendent and foreman—to learn what the other fellow is doing and to broaden out in your practice according to the standard set by the pacemakers in the casting trade. No deeper investigation of the needs of foundrymen is made than the constant, careful study of their requirements by the builders of equipment and the latest results of the efforts of these machinery manufacturers will be reflected by the acres of labor-saving devices that will be displayed in the International Amphitheater, where the exhibition, under the auspices of the Foundry & Machine Exhibition Co., will be held. You, your superintendent and your foreman, regardless of the efficiency of your practice, will be impressed by the wonderful improvements that have been made since the Buffalo show last year, and months in tours of inspection of other shops will not measure up, in educational value, to a few days' visit to Chicago during Founders' week. To attend this great exposition of foundry equipment, which will be held contemporaneously with the conventions of the three allied foundrymen's organizations, is a duty you owe your firm, yourself and every shop executive in your employ. The total expenditure that will be represented by this exposition will closely approximate $200,000. It is being made to enable you to effect still further economies by the installation of labor-saving equipment and you will be handsomely repaid for your small outlay and that of your employes, who help you to make possible your daily heat, in the reductions that you can bring about in the cost of your operation. The meetings of the American Foundrymen's Association and the American Institute of Metals promise to be productive of an unusually large amount of valuable information for the iron, steel and brass foundryman and the practical suggestions of how others have overcome their difficulties will prove helpful to you, and to those associated with you in capacities of authority, in solving the perplexing problems that recur with obstinate frequency in the conduct of your shop. One hint may be the means of saving you hundreds, probably thousands of dollars and the chance of obtaining one new idea is offered at odds that should compel your presence in Chicago during Founders' week. To prevent the possible disorganization of your plant by the attendance at one time of your shop executives, arrange to have them make this trip in relays. The exposition will continue seven days, and if necessary the respective visits of your men can be limited to two or three days, thereby eliminating any objection you may have to the absence of your entire executive force at one time. Personal contact with others engaged in your line of manufacture is another feature of affairs of this kind that promotes a better spirit throughout the industry and develops a more kindly feeling towards your competitor. This is a get-together age in the manufacturing and commercial world and that the foundry trade has been imbued with this idea will be indicated by your presence and that of every foundryman, in Chicago, during Founders' week.

Equipment for the Foundry and Pattern Shop

The Mumford Electric Jolt-Ramming Molding Machine—Fan Ventilator—New Osborn Machines and the Bridgeport Squeezer

THE development of the electric jolt-ramming machine has now reached a point where it may be considered one of the standard foundry appliances. Among its other advantages, the electric jarring machine is often specially desirable, because it does not add to demands on an already overtaxed air compressor. Foundries usually buy their electricity from central stations, which are equipped to furnish power in practically unlimited quantities. Even a large electric jolt machine will not add very much to the cost of electric current, because it only uses power momentarily. A machine with a lifting capacity of 40,000 pounds will require from 100 to 150-horsepower when it is in operation, but such a machine has done a good day's work in many shops if it has rammed 12 half molds, each one requiring about one-half minute of actual work.

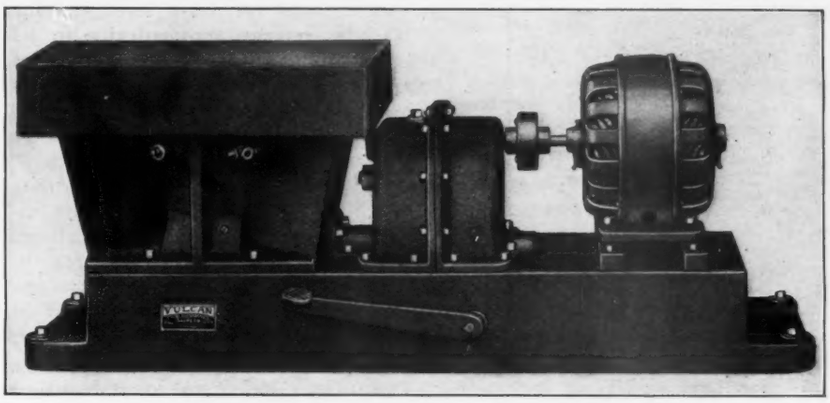


FIG. 1—MUMFORD ELECTRIC JARRING MACHINE

New Type of Machine

Realizing that there are conditions where the installation of an electric machine is desirable, the Vulcan Engineering Sales Co., Chicago, has perfected an electric jolt-ramming machine, which has a number of interesting features. It was designed by Edgar H. Mumford, who has been prominently identified with the development of the molding machine business for many years. The new machine is being manufactured by the Mumford Molding Machine Co., which is controlled by the Vulcan Engineering Sales Co. Its general features are illustrated in Fig. 1, while Fig. 2 shows a section of the jolt table and details of the operating mechanism.

The machine, with the driving motor and gear reduction, is mounted on a single, solid, cast iron base. The gear box contains four cast steel gears without teeth, having a speed ratio of 10 to 1. A foot lever on the front of the machine operates a positive clutch, which throws the cam shaft into gear. The moving parts revolve in oil and are packed with dust-proof gaskets.

The table is lifted and dropped by means of a cam on the end of the driving shaft; the cam revolves under a roller fixed to the lower end of the guiding plunger of the machine. During the experimental work, it was found that the lateral effect of the cam is sufficient to tip the table slightly, causing the mold to travel on the table in the direction toward which the cam revolves. To avoid this an idler roller, carried in a frame having a long radius, has been added to the mechanism. This compensates the lateral thrust of the cam.

In pneumatic machines, smoothness of action is generally produced by an exhaust cushion, which checks the table by air resistance for an instant before the final impact. This prevents the mold from dancing on the table, because it bears down with a pressure considerably exceeding its own weight due to the energy in its arrested motion.

Control of Blow

The quality of the blow is controlled in the Mumford electric jolt rammer by a simple device. A horizontal check valve admits air freely to the space between the enlarged upper end of the plunger and the reduced neck of the cylinder, through which the lower end of the plunger passes. A globe valve or pet cock is also screwed into the cylinder chamber. The only way the air admitted through the check valve can find egress, is through the globe valve, which may be opened at the will of the operator. Both ends of the plunger are fitted with packing rings and if the globe valve is entirely closed, the blow of the table is so cushioned as to have no ramming effect. By opening the valve the strength of the blow is increased at will up to the capacity of the machine.

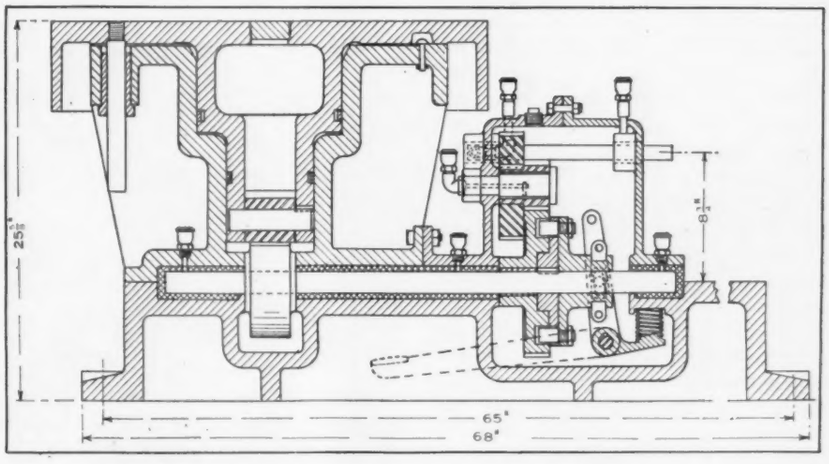
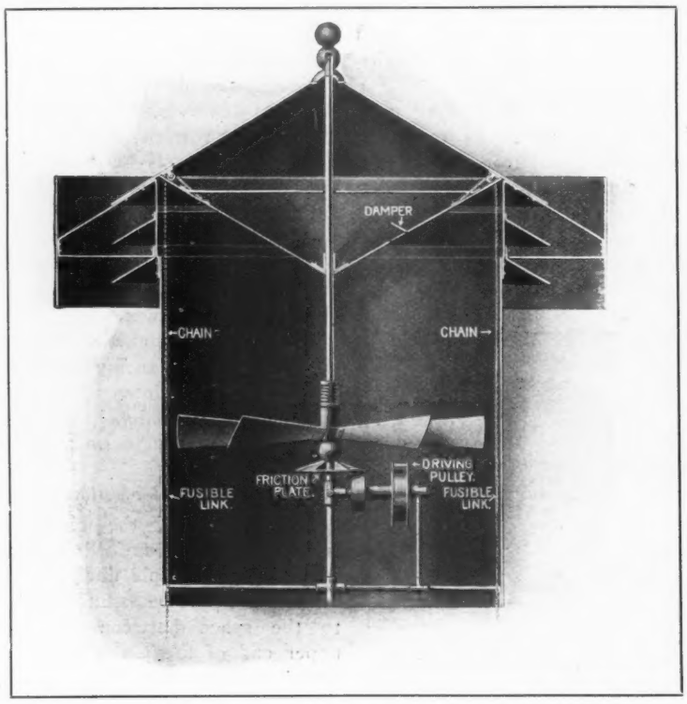


FIG. 2—CROSS-SECTION OF ELECTRIC JARRING MACHINE

Fan Ventilator for Foundry Buildings

The satisfactory ventilation of foundry buildings, including not only the casting shop, but other allied departments including the plating works, etc., merits the careful consideration of engineers designing such plants and managers, superintendents and foremen in charge of operations. In the accompanying illustration is shown a type of fan ventilator built by the Burt Mfg. Co., particularly designed to meet the requirements of severe shop conditions and adapted to the ventilation of iron, steel and brass foundries, plating shops, etc. The ventilator is so constructed that the fan operates at a speed of 250 to 300 revolutions per minute and tests have shown that it will remove 10 times more air in a given length of time than a ventilator of the stationary type. In case of fire the fusible links shown in the chain on either side, in the accompanying illustration, will break, thus causing the damper to drop, shutting off the draft. The fan can be operated either by a pulley or by a motor. Where desired, the fan can be reversed so that cold air can then be forced into the building.

This style of ventilator is manufactured in two sizes, 36 and 48-inch. As the fan is fully equipped with ball bearings, the power required to operate it is only one-fourth horsepower.



SECTIONAL VIEW OF BURT FAN VENTILATOR

A. L. Brooke and R. D. Mackintosh, Mortlake, Eng., have made an alloy of aluminum, nickel and magnesium, consisting of aluminum, 90 per cent; nickel, 9 per cent, and magnesium, 1 per cent. The aluminum is melted in a lined crucible and oxide of nickel is added, the charge being heated to 1,600 degrees Cent. to promote a reduction of the metallic nickel. The metallic magnesium is added last.

New Osborn Molding Machines

The line of molding machines built by the Osborn Mfg. Co., Cleveland, has been extended by the addition of two new types, including an air squeezer and a hand-operated roll-over machine adapted to a wide variety of work. The air squeezer, illustrated in Fig. 1, is built in three sizes, namely, 10 x 32 inches and 13 x 36 inches with wheel base, and 16 x 42 inches without wheel base. The ramming pressure can be adjusted from 30 to 100 pounds per square inch, and when the desired compression has been attained, the valve not only prevents additional pressure, but signals the operator by the escaping air that the mold is finished. The operator then releases the valve lever and the machine returns automatically to its off position. All of the operating parts are protected from the sand, the table being provided with a shield or apron, which extends around the cylinder to a distance greater than the length of the ordinary stroke. The strain rods are made of nickel steel and are direct-connected to the cylinder casting, thereby eliminating the tendency to spring the machine when it is in operation. To facilitate the removal of sand from underneath the machine, ample space has been provided underneath the cylinder and its support to permit of shoveling. The squeezer is equipped with a side table, riddle bracket, parting-bag pocket, sponge pocket and blow valve with hose connection.

A roll-over machine, on which the

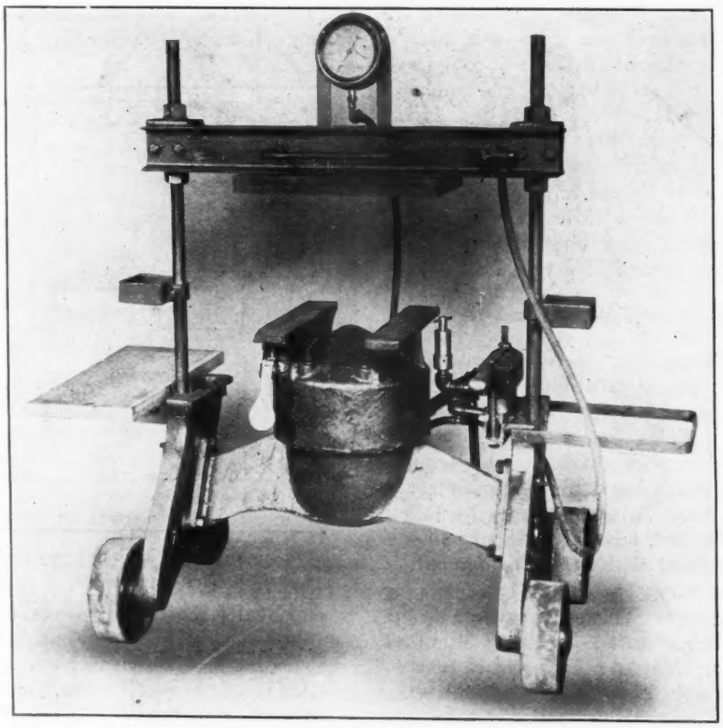


FIG. 1—OSBORN AIR SQUEEZER

mold or core is rammed by hand or foot power, is illustrated in Fig. 2. The flask or core box can be filled, rammed, rolled over, the mold drawn down and moved forward clear of the machine without compelling the operator to leave his position when ramming the mold. The mold is rolled over on a line slightly below the center of gravity and is brought to a gradual stop by a cam arrangement. A mold-receiving table is operated by a foot treadle, insuring an accurate gravity drop. When the receiving table is in position, the mold contacts with a four-pin leveling device that adjusts itself to any unevenness of the bottom board and the four pins are locked simultaneously. Depressing the foot treadle the second time lowers the table, drawing the mold away from the pattern or core box. The mold

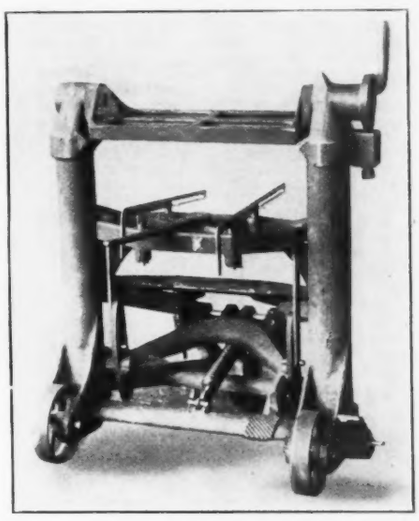


FIG. 2—OSBORN ROLL-OVER MOLDING MACHINE

or core then is drawn forward clear of the machine by sliding arms, which pass through slots in the leveling pins. At the side of the machine a foot treadle has been provided to effect the ramming of molds or cores by the jolting process. It has been ascertained that usually two or three jolts are sufficient to ram the sand for cores and some small molds, and hand ramming thereby is eliminated. This machine is built in three sizes, 22, 28 and 36 inches between trunnions with an 8-inch pattern draw. The two larger sizes, in addition to the 8-inch draw, are so designed that the pattern plate can be rocked-out, thereby securing additional draw, if required.

Sal-soda is crystallized sodium carbonate, while soda-ash is dry sodium carbonate. These names apply only to the commercial product, while the pure material is known as sodium carbonate.

Bridgeport Pneumatic Squeezer

A pneumatic squeezer designed for the production of snap flask and medium size floor work, built by the Bridgeport Die & Machine Co., Bridgeport, Conn., is shown in the accompanying illustration. The ramming of the mold is effected by a large air cylinder underneath the table, the piston elevating the table and the mold until the latter comes in contact with the presser head, thereby ramming the mold. The pattern plate is attached to the table for ramming either copes or drags, although the machine can be employed for ramming both halves of the mold simultaneously. After the mold is rammed, the table lowered and the head swung back, the pattern is vibrated, the vibrator valve being actuated by a knee pad shown at the right of the large cylinder. After vibrating the pattern and by further depressing the knee pad, the lifting mechanism is operated, air being admitted into two cylinders on either end of the machine, which are connected with four pins projecting through the top of the table. The pins contact with the parting edges of the flask, thereby lifting the mold away from the pattern. The vibration of the pattern can be continued throughout the lifting operation and as the lifting valve is adjustable, the speed of drawing the mold can be regulated to provide a slow lift for deep patterns and a quick lift for shallow work. The distance between the lifting pins also can be adjusted according to the length of the flask and the lifting pin levers are independently adjustable to insure a uniform draw. This machine is built also without the lifting device, but the latter can readily be attached if desired by the user. Two pneumatic vibrators are furnished with each machine, one being attached to the table, while the other is intended for gated or snap flask work. The side bars supporting the ramming head are made of seamless steel tubing of sufficient thickness to prevent springing. The ramming head is counterbalanced by two heavy spiral springs wound around the steel shaft extending lengthwise in the base of the machine. Each spring is readily adjustable to insure the accurate counterbalancing of the head. This machine is built in two sizes with cylinders 10 inches and 16 inches in diameter.

Samuel Edwards, Pittsburgh, recently has been granted a patent on a flux for coating iron or steel with lead by the hot process. This flux consists of, (1) muriatic acid, 100 pounds, and zinc, 2½ pounds; and (2) muriatic acid, 100 pounds; aluminum, 1 pound and sal-ammoniac, one-half pound. The zinc and aluminum are dissolved in the acid, and after the sal-ammoniac has been dissolved, the two solutions, (1) and (2), are mixed. The iron or steel to be coated with lead is first immersed in the flux so that the surface is practically coated, and then it is dipped in the molten lead, which is heated to 600 degrees Fahr.

Personal

F. G. Haldy, formerly connected with Yale & Towne Mfg. Co., has been appointed engineer for the Franklin-Moore Co., Winsted, Conn.

Henry Kohnle has resigned as superintendent of the foundry operated

POWER SQUEEZER BUILT BY THE BRIDGEPORT DIE & MACHINE CO.

by the French Oil Mill Machinery Co., Piqua, O., to accept a similar position with the Platt Iron Works Co., Dayton.

F. S. Scoville, formerly secretary and sales manager of the H. E. Mills Mfg. Co., Syracuse, N. Y., is now associated with the Standard Sand & Machine Co., Cleveland, and will devote his efforts to the sale of mixing, screening and sand conveying equipment for foundries.

Arthur Leidig, one of the managing directors of J. W. Jackman & Co., Ltd., London, Eng., British agent for Henry E. Pridmore, Chicago, will arrive in this country early in October to attend the exhibition of foundry equipment and supplies and the foundrymen's conventions to be held in Chicago from Oct. 10 to 17.

WHAT THE FOUNDRIES ARE DOING

Activities of the Iron, Steel and Brass Shops

The Atlantic Foundry Co., Akron, O., is completing an addition to its plant.

The Commercial Foundry Co., St. Louis, has been incorporated for $25,000 by F. P. Giggs, J. P. Becker and C. O'Loughlin.

The firm name of the Charleston Foundry Co., Chicago, has been changed to the Chicago Stove & Range Co.

F. P. Rohtert, Nashville, Tenn., has purchased the Roemer-Worrick Machinery Co., Bowling Green, Ky.

The West Michigan Steel Foundry Co., Grand Rapids, Mich., is installing a Shaw electric traveling crane in its main foundry building.

The Tube & Pipe Bending Co., of Ontario, Ltd., Toronto, Ont., has been incorporated for $100,000 by James F. Edgar, James E. Mabee, N. R. Tyndall and others, to carry on a foundry and machine shop business.

Operations will be begun shortly by the Huntington Machine & Foundry Co., Huntington, Ind. The plant will be modernly equipped. C. F. Heinss and H. E. Oscamp, Cincinnati, are the owners.

The plant and equipment of the Franklin Foundry Co., Franklin, Pa., has been sold at receiver's sale to three of the former partners, John Morrison, Franklin, Pa.; U. C. Kennedy and Mrs. C. A. Kahle, Oil City, Pa.

The Keystone Steel Foundry has been reorganized as the Kiskiminetas Steel Casting Co., and the plant at Avonmore, Pa., idle for several years, will be placed in operation. H. C. Barnhart is general superintendent.

Amalgamated Motors, Ltd., Toronto, Ont., has been incorporated by John F. Selby, William H. Smith, Thomas O. Pardoe and others to manufacture motors and to carry on the business of machinists, founders and engineers.

The Siebers & Raisch Pattern Works, 686-690 National avenue, Milwaukee, have established a branch at Waukesha, Wis., for specializing in job work for the brass, iron and aluminum foundries of that city. Mr. Raisch is in charge of the branch.

C. J. Nelson has sold his interest in the Nelson Foundry Co., North Milwaukee, Wis., and has organized the Nelson Co., which is building a foundry and machine shop at Menominee Falls, Wis. The North Milwaukee plant was burned last year. The new company takes over the transmission business and will make shafting hangers and boxes. The old company will specialize on gray iron foundry products.

New Construction

The Marion Machine, Foundry & Supply Co., Marion, Ind., will make additions to its plant.

Louis P. Weidig, Zanesville, O., has awarded the building contract for a new foundry to P. Mast, that city.

The Deere & Mansur Co., Moline, Ill., will build additions to its foundry at a cost of $25,000.

The Swedish Crucible Steel Co., Detroit, will build a foundry at Butler avenue and the Grand Trunk railroad, that city.

Additions, including a foundry, blacksmith shop and warehouse are being made at the plant of the McEwen Mfg. Co., Tulsa, Okla.

The Sharon Foundry Co., Sharon, Pa., will erect three fireproof pattern storage buildings, 50 x 150 feet, to replace those destroyed by fire.

A gray iron foundry will be erected by the Cloverport Bolt & Machine Co., Cloverport, Ky., which has been reorganized with William Pate as general manager.

The Lunkenheimer Co., Cincinnati, O., plans to erect an iron foundry, 150 x 300 feet, at its Fairmount works at a cost of from $150,000 to $200,000.

The Eberhard Mfg. Co., Cleveland, will build a brick addition to its plant, two stories, 45 x 215 feet. The first floor will contain the nickel-plating department and the second the buffing and polishing rooms.

An addition is being built to the cast manganese steel department of the Curtis & Co. Mfg. Co., St. Louis. A 100 x 150-foot addition to the steel foundry was completed recently.

The Frazer & Jones Co., Syracuse, N. Y., is building an addition to its Solvay foundry, which will increase the capacity 50 per cent. The new unit will be in operation before the end of the year.

Among the Brass Foundres

Higgins & Co., brass founders, 11 Park street, Holyoke, Mass., are adding another story to their foundry.

The Medina Iron & Brass Co., Medina, N. Y., manufacturer of plumbers' brass goods, will erect a new foundry 90 x 115 feet.

The Ideal Brass Works, Indianapolis, Ind., has been organized with $10,000 capital by E. F. McCoy, E. M. Adams and D. L. Stone.

The Diamond Match Co., Barberton, O., will erect a brass foundry, and considerable new equipment will be purchased. Plans for the new shop are now being prepared.

The Tallman Brass & Metal Co., Hamilton, Ont., has purchased the plant and machinery of the Lomas & Nelson Art Metal & Electric Fixture Co.

The Mt. Carmel Brass Foundry Works, Inc., Hamden, Conn., has been incorporated for $50,000 by W. G. Mayer and R. Biondi, Waterbury, Conn., and B. Wesbecher, New Haven, Conn.

The Guelph Brass Foundry Co., Guelph, Ont., has been organized to manufacture brass castings and electrical fittings. E. S. Tolmie is president and treasurer, and A. C. Thompson, vice president and secretary.

The Lumen Bearing Co., Buffalo, is building an addition to its plant which will provide 15,000 square feet of additional floor space. On the ground floor of this addition provision is being made for increased storage facilities and on the second floor will be located the babbitt metal room, carpenter shop and experimental department.

Want Advertisements
Too Late To Classify

WANTED: — POSITION AS BRASS foundry foreman. 25 years experience; 10 years as foreman. Specialty shop preferred. Best of references. Address Box 513, THE FOUNDRY, Cleveland, O.

POSITION WANTED: — A CHILLED car wheel foreman who has had 15 years experience with one of the largest wheel manufacturers in the country is open for a position. Can make mixtures by analysis. Married, 36 years old; best of references. Address Box 517, THE FOUNDRY, Cleveland.

PRACTICAL FOUNDRYMAN, 45 YEARS old with over 28 years' experience in the foundry making stove plate and light gray iron castings in various parts of the United States. 20 years experience as foreman and superintendent of various shops. Thoroughly posted on mixing, melting and general cupola practice, making and rigging up aluminum match-plates, rigging up and operating molding machines and understand what economy in the foundry means in getting general results at the end of the year. Can furnish best of references and want a position with some good concern that appreciates the efforts of a good foundryman. Address A. M. K., THE FOUNDRY, Cleveland, O.

AS STOVE FOUNDRY FOREMAN — Thoroughly understands this business. Can get your work out right. Reliable and a worker. Address Box 518, care of THE FOUNDRY, Cleveland, O.

WANTED — TWO FIRST CLASS PATternmakers. Write giving experience and wages wanted. Only high grade men need apply. Address Box 514, THE FOUNDRY, Cleveland, O.

WANTED: — EXPERT SUPERINTENDent for manganese steel foundry of 150 to 200 tons monthly capacity, to be erected. Salary six to eight thousand per annum. State experience and reference. Address Box 520, THE FOUNDRY, Cleveland, O.

FOREMAN OF MALLEABLE CASTINGS foundry who can take full charge of casting, molding and annealing. To a producer of good malleable castings we offer an extraordinary opportunity with privilege of buying stock if desired. Address Box 515, THE FOUNDRY, Cleveland, O.

WANTED—THREE YOUNG MEN WITH three to five years experience in a foundry, to learn to run continuous molding machinery and to learn the system of operating a continuous foundry on special work. Address Box 516, THE FOUNDRY, Cleveland, O.

FOR SALE. — SECOND-HAND TUMBling barrel; back geared, heavy duty, 40 by 48 inches. In good condition. Three cents per pound. Champion Machinery Co., Joliet, Ill.

FOR RENT: — FOUNDRY FOR SIX molders, first class equipment and location. Address Box 519, THE FOUNDRY, Cleveland, O.

FOR SALE:—SMALL FOUNDRY BUSIness in Denver employing four to six molders steady on contract and custom work. Sales, $2,000 to $3,000 a month. Must leave account of health. Address Box 512, THE FOUNDRY, Cleveland, O.

THOROUGHLY COMPETENT FOREman wants position—Good mechanic and executive, used to light and medium work, both bench and floor, have good record as machine expert and a low molding cost; leading position only; best of references. Address Box 470, THE FOUNDRY, Cleveland, O.